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DIFFERENTIAL COGNITIVE ABILITIES.

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THE RELATIONSHIP OF PATTERNS OF COGNITIVE PROCESSES AND PERSONALITY TRAITS WERE INVESTIGATED IN THIS STUDY OF 6 GROUPS OF CHILDREN (120) IN GRADE 5. SCORES ON THE PRIMARY MENTAL ABILITIES TEST, IOWA ACHIEVEMENT TEST, AND CALIFORNIA TEST OF MENTAL MATURITY WERE USED AS MEASURES OF COGNITIVE PROCESSES. (JK)

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DIFFERENTIAL COGNITIVE ABILITIES

Cooperative Research Project No. 1040

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Stanford, California

1962

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PREFACE

The study which will be reported in the pages which follow is a product of the endeavors and cooperative goodwill of many people. Our primary thanks go to the children who participated as subjects, who worked with cheerful interest through many hours of testing; and to their parents, who were willing to have us work with their children as a means of contributing to the general fund of knowledge about children, without any individual return. We consider ourselves especially fortunate to have been able to work in the school systems of San Carlos and Redwood City. Superintendent Spinas and Assistant Superintendent Whitacre in Redwood City, and Dr. Beardsley, Superintendent in San Carlos, with Assistant Superintendent Burdette and Dwight Goodwin, school psychologist, in San Carlos, helped to explain our research to parents and to the school boards and gave us their active support through our year of work; the principals and the teachers in these two school systems were helpful and patient to a notable degree, providing us with working space and adapting themselves to our schedule of work in numerous ways. We wish to express our gratitude to these people, as well as to Superintendent Tindall in the Mountain View school district and Assistant Superintendent John Daley in San Mateo for providing children to serve as subjects for pretesting some of our measures.

The task of conducting many hours of group and individual testing fell to our research assistants: Miss Helen Bee, Mrs. Shirley Dorin, Mrs Carol Goodall, Mr. Ben Hammett, Mrs. Geraldine Harvey, and Mrs. Roberta Oetzel, and the project owes much to them, not only for

their care in administering measures and maintaining rapport with the children and their contributions to the planning of the project itself, but also for the early-morning hours when they carried and set up heavy equipment and the many times they made an extra effort to go back to pick up data from a subject who had missed a testing session, so that our scores would be complete. The scoring of tests and analysis of the data also involved the efforts of many people. To Dr. Pauline Adams and Miss Helen Bee, who served as research assistants during the analysis phase of the study, we wish to express our especial indebtedness, for their having mastered the techniques necessary for programming our data for computers.

There are many colleagues who have stimulated and helped us with their comments during our work. We are especially grateful to Dr. Dorothy Huntington in the Stanford Department of Speech Pathology, who helped us to set up our delayed auditory feedback technique; to Dr. James Gallagher of the University of Illinois, who, as a visitor in our laboratory, made us familiar with related work in the field; and finally, to Dean Robert R. Sears, Director of the Laboratory of Human Development at Stanford, for providing a congenial and supportive setting for our work.

Our thanks also go to Mrs. Judith B. Pierce, secretary to the project throughout its existence, who has worked on every phase of our work from the original obtaining of parents' permissions to the typing and proof-reading of this manuscript.

And finally, we wish to acknowledge with gratitude the support of the Cooperative Research Program of the U. S. Office of Education, whose grant of funds to us made this research possible.

Eleanor E. Maccoby
Lucy Rau
Stanford University
October 1, 1962

CHAPTER I. INTRODUCTION

This study is an exploration of differential patterns of cognitive ability. We selected groups of children who showed marked discrepancies in their scores on tests of different primary mental abilities, as these have been described and measured by Thurstone. Since we did not wish to study variations in total IQ, our groups were matched with respect to general intelligence (i.e., total score on the Primary Mental Abilities Test). We were interested specifically in discrepancies between verbal, numerical, and spatial abilities. Having identified groups of children who showed significantly greater ability in one of these areas than another, we carried out an assessment program in which we obtained a variety of measures of these children's personality traits and modes of cognitive functioning.

The educator, the clinician, and the developmental psychologist have, in the course of their professional experience, come across many children with discrepant abilities. Although it is true that the cognitive development of most children is more even, we are familiar with the highly verbal child who has a "block" when it comes to learning mathematics, the child who has great difficulty learning reading and other language skills although he may be a "whizz" at numbers,or the child who is outstanding in his ability to manipulate spatial relationships although he may be quite mediocre at more academic tasks. How are we to account for these marked differences in the patterning of cognitive skills? It is entirely possible, of course, that genetic factors make a contribution to specific abilities just as they have been shown to have a part in determining differences in total intelligence, as measured by standard tests. We made the basic assumption, however, that experiential factors also make a contribution.

There are two streams of research, both of which seem to be coming out at the same point, which bear on this general assumption. As will be evident from our review of this research in the next section, both the work on factors which influence the growth of general intelligence and the work on the antecedents of cognitive styles point to the existence of emotional factors which account for some of the variance in intellectual functioning. The existence of some such relationship has long been assumed by those who work professionally on such problems as school phobias or reading-readiness in the young child, as well as by pre-school and primary grade teachers. A child who cries in the school room over separation from his mother or has fits of anger over the frustration entailed in sitting still and following the teacher's directions is obviously not in an optimum state for learning. While textbooks in child psychology typically have one set of chapters on cognitive development, another on personality development, and perhaps still another on emotional development, with little cross-referencing, the existence of relationships between the different kinds of processes has not been overlooked in psychological research and theory.

Psychoanalytic writers have long recognized such relationships. They refer, for instance, to a process of inhibition, which may be general (resulting in pseudo-imbecility) or specific, resulting in wide disparity among different intellectual skills. Freud discussed inhibition in the following terms: "An inhibition is the expression of a restriction of an Ego function. These restrictions have either been imposed as a measure of precaution or have been brought about as the result of an impoverishment of energy. The Ego renounces these functions in order to renounce coming into conflict with the Id." (Freud, 1926) This same connection between conflict and intellectual functioning is referred to by Plank and Plank (1954), whose work will be discussed in more detail below: "The close connection between the ebbing off of the oedipal conflict and readiness for more systematic learning in school has often been observed and stated." With recent developments in psychoanalytic ego-psychology such hypotheses have been extensively elaborated (e.g., Rapaport, 1951). We will discuss this theory, and some of the evidence bearing upon it, later at some length. At present, it is sufficient to note that psychoanalytic theory does deal extensively with the issue of the connection between emotional and intellectual processes.

This connection has also been the focus of a large body of work on anxiety and its effects (Sarason et al., 1960; Taylor and Spence, 1952; Matarazzo and Phillips, 1955). And finally, much of the work on achievement motivation has been concerned with the nature of the socialization process employed by the child's parents, and how this relates to achievement motivation and hence ultimately to performance on school achievement tests (Rosen and D'Andrade).

It appears to be true, then, that large numbers of developmental psychologists, as well as practitioners dealing with children, have taken it as a working hypothesis that a child's intellectual abilities, such as the ability to read quickly and with understanding, the ability to solve arithmetic problems, or the ability to do abstract reasoning, are not solely a function of innate endowment, but that these abilities are also functions in some degree of the nature of emotional and personality development which a child undergoes as a result of experience, particularly the interpersonal experience gained in early interaction with members of his family.

It would be misleading, however, to imply that this assumption is universal. There is considerable skepticism about it in some quarters. In his review of Witkin's earlier book, Postman (1955) warns against "the theoretical weaknesses of the intemperate 'clinicizing' of behavior." He says: "As one reads on it becomes increasingly disturbing to move through a looking-glass world in which small variations in psychophysical judgment loom as sinister symptoms of mental conflict and sophomores partial to visual cues in space orientation are seen as teetering on the brink of a breakdown. Such is the implausible and somber picture which emerges when concepts rooted in psychopathology are uncritically applied to the analysis of perception." Presumably, Postman would have the same misgivings about attempts to apply these same kinds of concepts to the analysis of other kinds of intellectual differences in intellectual performance, such as those displayed in differing verbal or numerical abilities. It is not entirely clear whether Postman is challenging the application of concepts derived from studies of abnormal people to individuals within the normal range, or whether he objects to the application of concepts growing out of personality theory to another area of functioning, such as perception.

We share Postman's misgivings over "intemperate clinicizing." Yet we do not find it implausible that, within the normal range of individual variation in perceptual behavior and modes of thinking, there may be some determinants of this variation which fall within the class of variables which have been identified by personality theorists, such as mechanisms of defense. To say this does not imply that we believe a particular mode of thinking or perceiving means as individual is "teetering on the verge of a breakdown." There are many patterns of personality organization, any of which may be considered "normal," or "adjustive," but which nevertheless reliably distinguish individuals from one another, and which could quite plausibly be related, in some causal or "permissive" way, to aspects of intellectual development. We do not believe that intellectual development occurs in an autonomous fashion, insulated from the so-called "dynamic" aspects of the individual's growth. Yet the evidence for relationships between intellect and personality is so far quite scattered and incomplete, and theoretical formulations which would enable us to predict in detail from one class of variables to the other are poorly developed. We believe the area is worthy of further exploration, and the present study is an effort to make a contribution to it.

In exploring the relationships between patterns of cognitive functioning and personality development, various methods are possible. One can relate differences in scores on tests of intellectual factors to differences in parents' socialization practices and, more broadly, in parent-child relationships. This obviously involves direct study of parents as well as children. Alternatively, one can study the personality traits and interpersonal relationships of groups of children who exhibit different patterns of mental abilities. The literature to be reviewed in the next section contains examples of both these approaches. Thirdly, one could experimentally manipulate variables hypothesized to affect cognitive functioning in one or another area and observe the effects of such manipulations on selected or unselected groups of subjects. (The experiment by Lance Canon, reported in Appendix IV, provides an example of such a study, carried out with a different group of subjects from the ones used in the main project.)

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It is primarily the second of these approaches we have chosen to pursue. A concurrent project was carried out by Dr. Elizabeth Bing in which she did study the socialization practices used by the parents of some of the children in our sample. These results are being separately published (Bing, 1963), and we have included sections of Bing's report in Appendix II of the present report. We shall refer to her findings in the interpretation of our own results, but the present report does not deal primarily with this class of antecedents.

We have chosen to study a set of variables which we believed were the outcome of certain early socialization experiences and relate these to the modes of intellectual functioning we believed they should foster, rather than to investigate the socialization practices themselves. We are thus focusing on mediating processes, presumably themselves growing out of the individual's past history, and currently operating to reinforce the existing pattern of abilities. It is always possible, of course, that certain patterns of abilities and certain other current characteristics grow out of the same antecedent conditions but do not currently interact. If this is true, it would be misleading to refer to either class of variables as "mediating." But we do believe that there are some linkages between spheres of current functioning which justify the use of the term "mediation" as well as reflecting common antecedents, and it is upon assumptions about these linkages that our hypotheses rest.

Our hypotheses concern two groups of variables. First, we have predicted relationships between our differential patterns of primary abilities and such variables as dependency and aggression, i.e., personality traits or interpersonal characteristics. Secondly, we have predicted relationships between the patterns of mental abilities and certain aspects of perceptual or psychomotor functioning. Here we are making the general assumption that interpersonal experiences and the resulting interpersonal tendencies may exert a facilitating or inhibiting influence on aspects of cognitive development which will be mediated through, among other channels, differential facility in certain psychomotor functions or differential "preference" for certain sensory cues. Schachtel (1959), for instance, suggests the interesting hypothesis that the process of socialization as it normally proceeds in our culture involves selective desensitization to certain modes of sensory experience and growing utilization of other sensory cues. We have sought data relevant to this issue.

Our specific hypotheses, together with the rationale for them, will be presented below. First, however, it seems relevant to set the present study in the background of previous research.

CHAPTER II. BACKGROUND AND REVIEW OF THE LITERATURE

General background

The present study lies in the fast-growing area of overlap between studies of intelligence and studies of personality. Research on intelligence, beginning with the original attack on measurement and definition by Binet and Terman, has diverged into several distinct lines of work. In the thirties, Thurstone insisted that intelligence was not a homogeneous trait, but could better be defined as a cluster of distinct primary abilities, and that an individual's intellectual abilities should be described in terms of a profile of scores rather than a single score. Guilford has continued the search for underlying dimensions which contribute in varying degrees to a wide variety of intellectual skills, and has pointed to a much larger number of factors than Thurstone identified. These factors, Guilford believes, can be classified in terms of certain even more basic dimensions of intelligence.

A different approach to the study of the processes underlying intelligence has been provided by the students of "cognitive styles" or "cognitive controls." (Witkin, et al., 1962; Witkin, et al., 1954; Gardner, et al., 1959; Kagan and Moss, 1963). While Thurstone and Guilford have been engaged in trying to classify intallectual performance and determine the minimum number of functions which will account for their co-variance, the researchers interested in cognitive style have been concerned with the hierarchical organization of intellect -- an organization that implies dependence of some functions on others. For example, an individual might develop an habitual mode of perceiving which involved rapid and extensive scanning of the stimulus field.

This mode of dealing with stimulus materials would then make a difference in how an individual handled a wide variety of tasks, from mirror drawing to reading. The initial work on cognitive styles was devoted primarily to identifying dimensions along which individuals varied reliably and with respect to which individuals remained reasonably stable over time. Recently, there has been some research designed to determine the antecedent conditions which underly the development of different cognitive styles (Witkin et al., 1962; Kagan and Moss, 1963), and in this work the nature of the parent-child relationships has emerged as being of central importance.

At the same time that work was being done on the separate factors involved in intelligent behavior, and on the "cognitive styles" underlying such behavior, there has been a parallel stream of work involving measures of "total intelligence." There have been studies of the "gifted" child or the "retarded" child -- so designated on the basis of a global score such as the Stanford Binet IQ or a total score on the Wechsler test. These studies have explored a very wide range of individual functioning, including social adjustment and various aspects of personality, and have reported significant relationships between the child's level of intellectual functioning and his social and emotional characteristics. Concurrently, there has been much concern with the stability of the IQ and conditions associated with changes in measured IQ. There was the famous controversy centered around the work at Iowa (by Wellman, 1945; Skeels et al., 1938). These researchers believed that children's intelligence could be raised through appropriate changes in environment. There was a strong reaction against this view on the part of psychologists who had come to think of the IQ as a measure of innate capacity. The critics of the Iowa school may be said to have won the battle but lost the war. Some sound methodological criticism was leveled at the Iowa studies (McNemar, 1940), but subsequent work has shown that there is indeed a relationship between measured IQ and certain aspects of children's immediate or long-term environment. This has been shown through a few experimental studies in which groups of children are subjected to a facilitating environment, following which measurably greater improvements occur, either in total IQ or in some ingredient of this such as verbal ability than are found in a control group (Dawe, 1942; Irwin,1960). In addition, there have been longitudinal studies of IQ which have demonstrated considerable variability in measured IQ (Bayley, 1949; Sontag et al., 1958; Bayley, 1961) -- variability which appears not to be entirely accounted for by technical defects of the construction and standardization of the tests used, nor by maturational factors alone. Of especial interest is the view presented by Sontag and his co-workers (1958), that changes in the IQ are predictable on the basis of certain aspects of personality development in early childhood, which are in their turn rooted in the interrelationships of the child and his parents.

We see that the two streams of research we have been describing are coming out at the same point. Both the work on factors which influence the growth of total IQ, and the work on the antecedents of cognitive styles point to the existence of emotional factors (growing out of the child's experience in interaction with significant other people) which account for some of the variance in intellectual functioning.

We now wish to consider what is known concerning the antecedents and correlates of specific intellectual abilities, of the sort traditionally measured in aptitude and achievement tests.

Studies of differential abilities

It is true that scores on the separate components of intelligence are usually substantially correlated. Yet the existence of individuals who show much greater competence in one area than another has long been noted. These discrepancies are sometimes so extreme as to have given rise to the term "idiot savants" to describe people who were capable, for example, of phenomenal feats of memory for numbers while being unable to learn to read. Systematic studies of individuals who do display discrepant patterns of abilities, however, are rare. There has been some research on the conditions which underly the rapid development of verbal ability per se, regardless of whether this development is accompanied by strength or weakness in other abilities. Dorothea McCarthy has summarized this work (1961). Such studies have shown that only and older children have the most rapid verbal development in early childhood, twins the least rapid, and these facts have been interpreted in terms of the greater amount of time parents are able to spend with the first child, stimulating and teaching him. Experimental studies (Dawe, Irwin) have also demonstrated an improvement in level of verbal behavior with verbal stimulation from adults. And Milner's study (1951) demonstrated that among Negro first-graders, the most verbally skillful children came from families in which there was a higher frequency of verbal interchange between parent and child than was the case with the children with poor language skills. We know, then, that extensive adult-child contact is likely to be associated with good verbal development in children; but it does not follow that numerical or spatial abilities are not associated with such contact. We simply do not have as much data on the conditions associated with the rapid development of these abilities. There are some suggestive guides in the literature. One of these is the finding that the children studied by Levy and described in his book, Maternal Overprotection (1943), were relatively skillful at verbal tasks and relatively poor at numerical ones. We quote from this report:

> Study of the educational achievement (of overprotected children) reveals an interesting finding which may help in tracing the pattern of overprotection in regard to school work. Review of the interests, school grades, and achievement tests of Group I children shows, in spite of variation in intelligence and economic levels, relatively high success in language (vocabulary, composition, "English"), poor scores in arithmetic, and special interest in reading, a feature in significant contrast with our check group. (Levy, p. 76)

On the basis of this evidence taken from extreme cases, then, there is some reason to believe the particular patterns of early parent-child relations which Levy has labeled "overprotection" has a different relationship to verbal than to numerical ability. It should be noted, too, that these highly overprotected children were described by Levy as being quite poor in interpersonal adjustment with their peers, being either too "bossy" and aggressive, or too shy and withdrawn, to make friends easily.

Conclusions consistent in most respects with Levy's findings are drawn by Plank and Plank (1954) in their search of autobiographies of people who were either unusually skillful at arithmetic, or unusually poor at it, in relation to the level of their other skills. The outstanding figures of literature and history who reported having great difficulty with arithmetic during their school years (including Winston Churchill) appear to have had very close relationships with their mothers, which continued through their school years. Plank and Plank interpret this fact as follows: "Learning of mathematics becomes blocked where the first and strongest object relationships cannot be replaced and therefore symbols cannot replace objects." In contrast, they find that the individuals who were outstandingly good at arithmetic typically experienced a disturbance in their early dependent relationships to their mothers; in some cases the mother died, in others there was separation from her for some other reason, and in still others, the child simply never developed a strong attachment to his mother, despite her physical presence. One of the cases cited was that of Bertrand Russell, who recollects arriving at his grandparents' home at the age of three:

> My father . . . had recently died, after a long period of gradually increasing disability. My mother and my sister had died of diptheria about a year and a half sooner. Throughout my childhood I had an increasing sense of loneliness, and of despair of ever meeting anyone with whom I could talk. Books and nature and later mathematics saved me from these sorrows. At the age of 11, I began Euclid, with my brother as my tutor. This was one of the great events of my life, as dazzling as first love. I had not imagined that there was anything so delicious in the world. From that moment until I finished Principia Mathematica at the age of 38, mathematics was my chief interest and my chief source of happiness.

The case of A. A. Milne is also cited as an example of a child gifted in mathematics. His father wrote about him: "He thinks mathematics grand. He cannot determine whether algebra is better than football or Euclid than sponge cake." And Milne wrote concerning his own childhood:

> When I was a child I neither experienced nor felt the need of that mother love of which one reads so much and over which I am supposed (so mistakenly) to have sentimentalized. I learned no prayers at my mother's knee. It was papa who told us about God, and we who told the governess. My mother may also have felt that papa was so good at playing with a child and amusing a child and making a child love him that she oughtn't to interfere here either. Certainly as a child I gave my heart to my father.

Plank and Plank report their own experience in teaching three boys who were lightning calculators, and say that the children had suffered "unusual deprivation in their early relationships to their mothers." Their interpretation of these children's preference for numbers is as follows:

> Learning for these children became enjoyable only in relation to their interest in numbers, which allowed them to remain impersonal and to operate without images. Teaching in other areas became possible after the supremacy of arithmetic had been accepted and appreciated by the teacher. For these children, the concrete was dangerous, the abstract remote and safe.

A final point made by Plank and Plank should be noted: they believe that reading and numerical ability are differently related to the expression and control of aggression. They say:

> While reading, a child does not attack or destroy his material. Since he knows that it remains intact, he does not experience the anxiety which would surge up if the child were to perform an act of aggression that he cannot permit himself. The opposite is true of mathematical activity. There, the child has to manipulate, dissect, destroy figures; this he can do only if he can allow himself to express aggression. In fact, aggression can be harnessed by being turned against abstractions rather than human beings. We should therefore find parallel expression of aggression and mathematical interest.

Evidence for this point of view is offered from several autobiographies, including that of Napoleon, who is described as unusually good at mathematics but not very skillful at other subjects. Napoleon wrote of himself as a child:

> I was a headstrong child. Nothing overawed me, nothing impressed me. I was quarrelsome and pugnacious, and feared nobody. I struck one person, I scratched another, till all were afraid of me.

We have quoted Plank and Plank at length because, although the autobiographical and clinical material offered cannot be regarded as satisfactory evidence in itself for the existence of the motivational underpinnings of intellectual performance which the writers posit, the article is rich with hypotheses which can be put to a more systematic test. Plank and Plank appear to be saying that poor mathematical ability (accompanied by relatively high verbal ability) grows out of an unresolved dependency relationship to the child's mother. An exceptionally high level of mathematical ability, on the other hand, occurs only when this bond has been substantially weakened. In fact, when math ability is accompanied by a relatively low level of other abilities (particularly verbal ability), there is likely to have been some trauma in the history of the child's relationship to his mother, resulting in a defensive flight from interpersonal relations and a taking refuge in symbols, which are "neutral," "unthreatening."

All the material cited so far from Plank and Plank refers to their discussion of mathematical ability among men. They do have a briefer, separate discussion of the rare cases of mathematical genius among women, and say that in each of these cases the young girl had identified strongly with her father or some other male figure.

How consistent are Plank and Plank's views with existing evidence? Are there any theoretical grounds, other than the psychoanalytical analysis cited above, on the basis of which we might expect that the views are valid or invalid?

Turning first to other clinical evidence, the views of Plank and Plank would appear to be consistent with Levy's work, at least with respect to the nature of the mother-child relationship which exists in the case of high-verbal low-math children. But Levy did say that at least one sub-group of his overprotected children were aggressive in relation to their peers; according to Plank and Plank, it should not be the overprotected (and hence high-verbal low-math children) but rather the high math children, who had been detached early and perhaps traumatically from their mothers, who would be especially aggressive.

Additional evidence concerning the characteristics of children with different patterns of abilities is provided by Haggard (1957), in a report on a group of 45 gifted children. While these children all fell at the high end of the distribution of scores of intellectual ability and achievement, there were differences in the pattern of abilities; some of these children displayed their greatest strength on arithmetical tasks, others on verbal tasks. Haggard and his colleagues found it necessary to differentiate between reading ability and ability at other language skills such as spelling and punctuation. These two aspects of verbal ability did not correlate consistently with one another, and they related to different constellations of personality traits, so Haggard reports the correlates of three varieties of academic achievement: arithmetic, reading, and "language" (including spelling).

For our purposes, we are primarily concerned with the first two. Haggard's report is an impressionistic one (no tables are presented), based upon data from projective personality tests, behavioral observations, teachers' ratings, and measures of parental achievement pressures. He says about the children who are better at reading than in other academic areas:

> The high achievers in reading seemed to have withdrawn into themselves and to view their world and the people in it from a distance. The reactions to their parents and other authority figures were mildly negative -- a fact which may have reflected their desire for isolation from external pressures and controls, or their wish not to become involved with others but to live within themselves . . . These children had difficulty in expressing affection or hostility openly, had difficulty in relating to others, and lacked the facilities for developing and maintaining such relationships.

In contrast, the high achievers in arithmetic are described in the following terms:

> (they) tended to see their environment as being neither threatening nor overwhelming. Rather, they viewed it with curiosity and felt capable of mastering any problems they might encounter. In viewing their parents and other authority figures, and in their relations with them, they showed less strain than the high achievers in reading, and greater independence than the high spelling achievers. Furthermore, the arithmetic achievers had by far the best developed and the healthiest egos, both in relation to their own emotions and mental processes and in their greater maturity in dealing with the outside world of people and things.
>
> The high arithmetic achievers could express their feelings freely and without anxiety or guilt; were emotionally controlled and flexible, and were capable of integrating their emotions, thoughts, and actions. On the sub-groups studied, the arithmetic achievers showed the most independence of thought, were best at maintaining contact with reality and at avoiding being bound by its constraints, and could function most effectively in the realm of abstract symbols. In their relations with authority figures and peers, they were more assertive, independent, and self-confident than were the children in the other sub-groups. Generally

> speaking, they related well to others, but, if they felt that attempts were being made to impose undue restrictions upon them, they tended to respond with hostility and self-assertion in order to maintain their independence and autonomy of thought and action.

A later, more quantitative report from this same study (d'Heurle, Mellinger, and Haggard, 1959), based upon data taken during a single year from a somewhat larger number of subjects, reveals that the correlations between abilities (as measured by school achievement or by primarily a mental abilities test) are quite small. For example, the correlation between "self-confidence," as measured by an observational rating, and an arithmetic test scores, is .27 (after Stanford-Binet IQ has been partialled out), a correlation which is significant at the .05 level. The correlation of self confidence with reading achievement is not significant, being under .18. But the difference between the two correlations is not substantial in an absolute sense. The d'Heurle report shows a negative correlation between "relaxation" and verbal ability, with no significant correlation being reported between "relaxation" and other abilities.

Not all the relationships pointed to in Haggard's summary (quoted above) emerge as significant correlations in the d'Heurle et al. report, and it is difficult to find corroboration in this set of published data for all the statements Haggard makes. For example, he describes the "reactions to parents and other authority figures" as being "mildly hostile" among the high achievers in reading, while the high achievers in arithmetic are said to "show less strain" in these relationships. The only measure reported which appears to be directly relevant to this statement is a measure called "positive reactions to mother," taken from the Children's Apperception Test. This measure correlated -.22 with the arithmetic test score, and -.24 with the reading test score. The latter correlation just reaches the 5% level of confidence, while the former does not, but this fact is hardly a basis for pointing to a difference in the nature of the relationship of this variable to different patterns of academic achievement. Haggard may have been basing his summary on additional data not yet published. Until the data are available, we can regard his report in the same light as we did those of Plank and Plank and Levy -- as a rich source of hypotheses. It may be useful to note some differences and similarities between Haggard's appraisal and that of the other writers previously cited. Plank and Plank, and Levy see the good reader as characterized by a strong dependency relationship to the mother; Haggard sees him as "withdrawn" and "mildly negative" toward his parents. Plank and Plank see the high-math low-verbal child as aggressive, and as engaged in a defensive flight from interpersonal relations, due to a traumatic interference with normal early dependency; Haggard sees these high-math children as showing relatively little strain in relation to parents, and "relating well to others." One final point from the Haggard study (as reported in the d'Heurle et al. monograph). There was a significant (though small) positive correlation between a child's having "overprotective parents" and his math score. No such correlation emerged for other intellectual abilities. This finding contradicts the previously reported relationship between maternal overprotection and a high-verbal low-math pattern of abilities. It is well to remember that the children Haggard studied were all generally competent, high-achieving children, and it remains to be seen how well his description would fit a less highly selected sample. But Plank and Plank were studying "gifted" people, too, and their observations are not entirely consonant with those of Haggard.

Haggard's impressionistic summary dealt with high achievers in arithmetic or reading, and did not discuss the children whose highest talents lay in the realm of spatial abilities. D'Heurle et al. report correlations between the PMA measure of spatial ability and certain personality variables. Space is the only one of the primary mental abilities which is significantly correlated with "rejection" (a projective measure derived from the Children's Apperception Test). Other measures taken from the same test reveal a small but significant correlation between space ability and "spontaneity, emotional expressiveness, and originality," traits which do not correlate with other primary abilities. But on the whole, the Haggard and the d'Heurle et al. reports deal more fully with number and verbal ability than with space ability.

The work of Ann Roe, reported in her book on the Psychology of Occupations (1956), may be relevant here. Her work dealt with the personality characteristics of people in different professional occupations. Some of the occupations which she discusses characteristically attract people with discrepant abilities. For example, she reports that geneticists and biochemists tend to score higher on non-verbal than on verbal tests; these men are characterized as tending to be non-social (not anti-social, but simply not much interested in other people), as well as persistent, non-aggressive, conventional, orderly, and controlled. Anthropologists, by contrast, score much higher on verbal tests than they do on non-verbal tests (including both tests of space ability and tests of mathematical ability), and they are characterized as having a strong interest in people, and a history of conflict with their parents, with aggression being fairly freely expressed. We see some points of similarity and some of difference between these clusters of traits and those previously described.

Another study which provides some data relevant to an understanding of differential abilities is that done some years ago by Nevitt Sanford and his colleagues (1943) at the Personality Assessment Clinic at Harvard. These researchers worked intensively with a group of 43 children over a three-year period, gathered information concerning both their intellectual and personality characteristics. The personality measures were derived primarily from projective tests and were analyzed according to Murray's list of needs. The scores on intellectual characteristics were derived by selecting sub-sets of items from the Stanford-Binet and finally, analysis of the family setting in which those children had grown up was done by rating the cases on a set of "family press" variables. Some of the findings may be summarized as follows:

> High-verbal children were: hostile, and high on "ego defense"; relatively low on "fondness" and "self-assertion"; their families were rated relatively low on acceptance, high on stability of the home, and high on the tightness of the control they exercised over the child.

> High-number children were: high on love, low on "need fantasy"; their families exercised tight control.

High-space children were: high on self-assertion, low on "social" motivation; their families were relatively unstable, low on the exercise of tight control.

There is an extensive literature on factors associated with reading disabilities. It is not possible to review all this literature here. But instances of comparison of good readers with poor readers, when the cases are matched on some measure of total intelligence, are relevant for our inquiry, since these children are comparable to those labeled high-verbal achievers and low-verbal achievers in other studies. We will present one study having such a design. Stewart (1950) selected 15 pairs of children matched for intelligence, sex, and socioeconomic status. One member of each pair was a good reader, the other a poor reader. The personality characteristics of the children were assessed, and the following are some of the contrasts Stewart reports:

Superior readers	Inferior readers
more withdrawn than aggressive	more aggressive than withdrawn
mothers more rejecting than overprotective	mothers ambivalent: hostile, capricious, and guilty; over-indulgent
fathers authoritarian or remote	fathers easygoing, relatively weak
feel need for more friends than can make or hold; easily rebuffed, on periphery of group	satisfied: want friends but feel they have them; but teachers report that they are not very acceptable to group: too aggressive
dependent on teacher's approval	less dependent on teacher
consciously fearful of parents	not consciously fearful of parents

We do not know that the children studied by Stewart were cases of discrepant abilities, but it is likely that they were, for the poor readers must have done especially well at some of the number or performance test items to earn an equal IQ score with their fast-reading counterparts. So here is another bit of evidence bearing upon the nature of the mother-child relationship in cases of especially high verbal ability; but it does not provide a consistent picture with the reports previously cited. These inconsistencies will be discussed later.

There are several instances in which researchers have taken advantage of the fact that American College Entrance exam scores are available for most college students, and that two sub-scores on this test are usually reported: the "Language" score and the "Quantitative" score. For any population of college students, then, it is possible to select those who showed a substantial discrepancy in these two scores, and to relate such discrepancies to measures of some of their other characteristics.

Munroe (1946) did such a study, selecting 40 students with the highest discrepancy of Language over Quantitative, and 40 with the highest discrepancy in the opposite direction, and administered the Rorschach to these students. She found no differences between the groups in the total number of responses, nor in a rating of "general adjustment" based upon the Rorschach, but she did find that the high-language group gave more movement responses (interpreted as meaning that these students were more "subjective"), and the high-quantitative group gave more form responses, interpreted as meaning that they characteristically made a more literal construction of objective reality.

Altus (1952) did a study of similar design, in this instance using women subjects only. Altus selected the 1/4 of a group of freshmen women having the greatest discrepancy of Q over L (100 cases in all), and the 1/4 with the greatest discrepancy of L over Q (again, 100 cases), and analyzed the scores of these women on the Minnesota Multiphasic

Personality Inventory. He characterizes the high-quantitative women (by contrast with the high-language women) as follows:

- they "deny" heterosexual impulses, although they say they have been in love; they like to be with other women
- they are religious, conventional, "good" (say they always tell the truth, were never sent to the principal for "cutting up" when younger)
- afraid of germs, worry about making sure the door is locked
- high in "anxiety" -- say they can't concentrate easily, shrink from crises
- socially sensitive, not shy, don't daydream much
- slightly higher in "resentful" attitudes

The high-language women were significantly different on each of these dimensions in their self-report on the MMPI. They more often said they did not like to be with other women, were not so religious, not so afraid of germs, etc. Altus says in summary about the quantitative girl: "one gathers the impression that she is immature."

Sanders et al. (1960) proceeded in similar fashion to select male college students with discrepancies in their ability scores. They included 30 in their Vq group (higher verbal than quantitative) and 30 in their vQ group (higher quantitative than verbal). They collected an unusual variety of dependent measures. In addition to administering the Holzman ink-blot test and two other personality instruments (the Edwards Personal Preference Schedule and the McGuire Q-check), they obtained physiological measures through an analysis of urine samples. Contrary to Munroe's findings, they did not find differences on the movement or form responses to an ink-blot test. They did find, however, that the high-Quantitative group had somewhat longer reaction times on this test. Results on the other personality measures showed that the high-Quantitative men, by comparison with the high-Verbal group, were characterized by:

less autonomy
more affiliation, dependency
less dominance
more endurance
less rejection of authority

One of the surprising findings of this study is that the Quantitative men secreted more urine per unit time than the Verbal men. The authors attribute this to their greater level of physical activity. The Verbal men tended to be sedentary, the Quantitative men athletic.

An especially interesting study of discrepant abilities in a population of college students was done by Kuckenberg (1962). Kuckenberg's work stemmed from that of John Whiting at Harvard on the effects of father absence. Kuckenberg's hypothesis was that the absence of the father during the early years of a boy's life would lead to the child's identifying with his mother, and hence displaying certain feminine characteristics later in life. She reasoned that verbal ability was more characteristically feminine than masculine, mathematical ability the reverse. Hence, boys whose fathers had been absent during their early childhood should do best in verbal tasks, boys whose fathers had been present should do best in mathematical tasks. In a population of college men at the time Kuckenberg's study was done, it was possible to find a significant number of men whose fathers had been away in military service during World War II. Kuckenberg computed discrepancy scores (the difference between scores on the quantitative and scores on the verbal sections of the ACE test) for college men whose fathers had been absent in their early childhood, and compared them with the discrepancy scores of men whose fathers had been present. The results sustained the hypotehsis: the greatest discrepancies of verbal over math scores were found among men whose fathers had been absent. A fuller discussion of the hypothesis, the Kuckenberg data, and the data from a replication done by Nelsen at Stanford, are to be found in Appendix III of this report. We will also refer to this hypothesis again in the discussion section following the presentation of our findings.

The final item in our review of the literature is a study by Cattell (1945), done during World War II with a group of 123 men enrolled in the Army Specialist Training Program. Cattell administered the math and verbal sections of the Graduate Record Examination to these men, and correlated the math and verbal sub-scores with scores derived from a personality inventory. He then partialled out general intelligence, as measured to the subject's total score on the Army General Classification test. Some of the discrepancies are shown below:

Correlation with math score (g factor partialled out)		Correlation with verbal score (g factor partialled
-.16	Demoralized, autistic	.00
.09	Cheerful, enthusiastic, witty	-.16
-.11	Hostile, paranoid	.07
.00	Sociable, hearty, not shy	-.26
.00	Tough, solid, talkative	-.20

We see that the correlations which remain after g factor is partialled out are very small. But there are some trends that may be detected. There is some likelihood that a man who does well on the verbal section of the GRE will be shy, unsociable, sensitive, moody, and this is not true of the man who tests high on the quantitative section of the test. Cattell also found that while there was a very slightly positive correlation between verbality and hostility, there was a small negative correlation between quantitative ability and hostility. In general, Cattell saw the high-verbal men in his study as showing a constellation of fairly feminine traits, and he saw them as somewhat more emotionally unstable than the high-math group.

Can any consistencies be discovered in the melange of findings reported above? It would appear that the scattered evidence (impressionistic reports coupled with a few quantitative studies) is not entirely consistent concerning the nature of the parent-child relationship that is associated with different patterns of intellectual abilities. The high-verbal child, or in some instances the high-verbal low-math child, is characterized as: "overprotected" (Levy), "more rejected than overprotected" (Stewart), "not accepted, but tightly controlled" (Sanford et al.), having a close, strongly affectionate relationship with his mother (Plank and Plank), in conflict with his parents (Roe), having his father absent in early childhood (Kuckenberg). The high-math child is characterized as having been detached from his parents at an early age (Plank and Plank), being overprotected (d'Heurle), being tightly controlled (Sanford), having both parents present in the household in early childhood (Kuckenberg). Even allowing for considerable differences among the writers cited in the meanings of the terms they employ, it is difficult to find a common thread in their findings, at least with respect to the high-math child. With respect to the high-verbal child, most of the studies would be consistent with the hypothesis that there is a high degree of contact between the mother and child. The bond is close, but there is disagreement as to the emotional quality of this relationship -- whether it is warm and affectionate, or rejecting and dominant. In any case, the existing evidence is by no means clear concerning the nature of socialization practices that are related to differential patterns of intellectual abilities, if indeed such relationships exist.

When we consider the studies we have summarized in terms of the information they provide concerning relationships between measured personality traits of children or adults and their patterns of intellectual abilities, the first point to note is that whenever quantitative data are provided, the relationships between the two classes of variables are small in magnitude and not very frequent in number, in relation to the total number of variables studied. Personality variables, as so far chosen, defined, and measured, do not appear to account for much of the variance in an individual's "choice" of the particular area where his abilities will be strongest or weakest. This is grist for the mill of those who would prefer to view cognitive development as a relatively autonomous process.

It should also be noted that what positive findings have been reported relate almost entirely to verbal or numerical ability. Studies of spatial ability are rare, and hence, in our attempt to summarize below we will confine our attention to the findings which relate to number and verbal ability.

Within the weak relationships that have been found, there are some fairly consistent patterns that lead one to suspect these are not merely random associations. And the relationships are not what might have been expected on the basis of stereotypes concerning the mathematician or the verbally-skilled person. Consider the descriptions which emerge from a variety of studies concerning the individual whose highest area of ability is verbal:

unable to make friends (either too shy or too "bossy")	Levy
withdrawn, difficulty in relating to others	Haggard
low on "fondness"	Sanford
more withdrawn than aggressive, feels need for more friends than can make or hold	Stewart
relatively shy	Altus
shy, unsociable	Cattell
less affiliation motivation	Sanders

Concerning the area of the individual's interpersonal relationships with others (in most of these instances, relationships with peers is what is being studied) the high-verbal individual consistently appears to be relatively unsocial, for whatever reason, by comparison with the high-math individual, who is described in essentially opposite terms to those given above. The study which provides the single exception is that by Roe of occupational groups, in which she finds that a high-verbal low-math group (anthropologists) are gregarious, are highly interested in people, while the high-math low-verbal groups (e.g., geneticists, biochemists) are relatively a-social.

Many other characteristics of indivuduals were measured in the group of studies listed, but it is difficult to obtain a clear consistent picture with respect to any of these, such as the nature of the subjects' dependency relationships to authority figures (Stewart says high-verbal individuals are more dependent, Sanders says they are less so), with respect to aggression, or with respect to general level of adjustment. Cattell sees the high-verbal person as "unstable," Haggard sees the same group as tense (or at least, low in relaxation), while Altus sees the high-math people as the more "anxious" group. The main area of consistency that does emerge, then, lies in the region of the individual's interpersonal relationships with his peers. Why this particular area of behavior should be related to an individual's pattern of intellectual abilities is something we will take up in the next section, and also in the "discussion" section following the presentation of the results of our own research.

CHAPTER III, HYPOTHESES

Since we began work on this study, our thinking has changed considerably, a fact which creates some difficulty in the presentation of theory and hypotheses. In the present section, we will attempt to give the reasoning which led us to some of our original predictions and the original choice of variables for measurement. Then in the discussion section which follows the presentation of our results, we will present our subsequent reformulations, and attempt to relate our findings to other current work and viewpoints on the relationships of personality and thought processes to one another.

Dependency-affiliation

We expected that the kind and amount of a child's affiliative and dependent behavior would be related to his pattern of cognitive abilities. We may reasonably assume that to some extent the patterns of abilities are "set" fairly early in childhood (Thurstone; Emmet, 1949). During the pre-school years, while some of this "setting" is occurring, we may identify a dependent child as one who spends as much time in the presence of significant adults as he can, and who has his attention fixed upon them. We assume that imitative learning is going on at this time, and that the more dependent the child, the more of the behavior characteristic of his model he is acquiring (Maccoby, 1961), including adult-like speech. We further believe that verbal ability is most facilitated by such modeling, space ability least, with number ability deriving some benefit but not a great deal. In interaction with adults, the child hears what adults say to him and to each other, and learns a good deal of this verbal content. When his parents are engaged in numerical thinking, however (computing the monthly bills or the income tax), they usually prefer to do so when children are not present, and even when children are present the parents' numerical thinking tends to go on sub-vocally (as in the calculation of a tip, or change-making) except in the instances where the parent is deliberately attempting to instruct the child in counting or the use of money.

In addition to the vicarious learning of verbal material that the child does while listening to adults talk, there is direct reward for his own verbalization, and this is likely to occur more frequently for the dependent child. Verbalization keeps him in contact with adults, and their responses to his verbal bids soothe him. The child's numerical thinking is not so useful to him in this way. An amusing example of this lack of adult rapport with a child's numerical thinking is provided by Bertrand Russell in his autobiography:

> I remember telling her (my grandmother) that I had grown 2 1/2 inches in the last 7 months, and that at that rate I should grow 4 2/7 inches in a year. "Don't you know," she said, "that you should never talk about any fractions except halves and quarters? It is pedantic!" "I know it now," I replied.

This could, of course, be thought of as an example of a bright child dealing with a not-so-bright adult. Nevertheless, it appears obvious enough that numbers and formulae are seldom used for communicative speech, by comparison with non-mathematical language. In Vygotsky's terms (1962), numerical thinking is primarily "inner" speech. We would therefore expect it to benefit less from a high level of interaction with other people. And spatial thinking should benefit even less. We hardly communicate our spatial perceptions at all. A child learns about spatial relationships primarily by manipulating objects and executing exploratory movements in space. A child who is closely bound to his mother's apron strings, either by her insistence or his own desire, will presumably acquire less of the experience with a variety of objects and places that comes from trial-and-error manipulation. We therefore expect that dependency would actively interfere with the development of spatial ability, facilitate verbal ability, and make little difference to numerical ability.

In formulating our hypotheses relative to dependency, we assumed a fair degree of continuity and generality in dependency as a personality trait. We assumed that the children who had been highly dependent during their pre-school years, when their pattern of primary abilities was being formed, would continue to be so up till the age of 11 when we studied them. We assumed further that there was positive transfer of dependency responses from parents to teachers, and to some extent, to peers. We therefore predicted:

Hypothesis 1. High-verbal children (as contrasted with low-verbal children) will be more dependent upon adults.

Hypothesis 2. High-verbal children will have a higher level of interaction with peers than will low-verbal children.

Hypothesis 3. High-verbal children will show less anxiety about dependency than children with other patterns of abilities.

Hypothesis 4. High-verbal children will be more sensitive to interpersonal cues than will low-verbal children.

The reader will note that our Hypothesis 2 is contrary to the findings of previous studies. At the time we planned our study, we had not summarized all the existing literature, and we banked more heavily on the generality of affiliative tendencies than now seems justified. In any case, we did predict greater sociability for high-verbal children, for we saw no reason to believe that high-verbal children would channel their affiliative behavior selectively toward one kind of target.

A word about Hypothesis 4. By "sensitivity to interpersonal cues" we mean that when given a choice of things to attend to in a complex situation, the high-verbal children will pay more attention to what other people are doing and saying, and less, to such impersonal elements of the situation as the arrangements of objects in a room or street noises. We also expect that highly verbal children will be more likely to infer motives or feeling states to others, while other children will give more "objective" descriptions of the behavior of others.

We have already pointed out that we believe number ability will not be especially facilitated by a high level of interaction between a child and his parents or peers. There is one respect in which such facilitation might occur: a child who wants reassurance and approval from adults might be more "teachable" -- in mathematics as well as other content areas -- so that he would do the necessary drudgery at school in order to win approval. If this were an important factor, we should expect a positive correlation between dependency and school achievement in all content areas. We were impressed, however, with the clinical observations that high math individuals were either relatively non-social (Roe), or engaged in active avoidance of interpersonal relationships (Plank and Plank). Earlier we gave Plank and Plank's statement of the psychoanalytic hypothesis that non-verbal symbolic thought is sometimes engaged in as a defense -- that it is less anxiety-arousing to individuals who are subject to intense conflict of the sort that arises from unsatisfactory early parent-child relationships. Following this line of thought, we predicted:

Hypothesis 5. High-number children will be low in dependency.

Hypothesis 6. High-number children will have a relatively low level of interaction with peers.

Hypothesis 7. High-number children will have a relatively high level of anxiety about dependency.

Hypothesis 8. High-number children will be relatively insensitive to interpersonal cues.

With regard to high-space children, we believed that these children would be those who had been given considerable freedom in early childhood to explore the natural environment, a form of independence training which we predicted would lead to the following characteristics:

Hypothesis 9. High-space children would be low on dependency.

Hypothesis 10. High-space children would be high on independence and "mastery" (competence in dealing with the natural environment)

Aggression

We predicted differences in aggressive tendencies (expression and inhibition of aggression) between both our high and low-number groups and our high and low-space groups. Our reasoning in the two cases was somewhat different. With respect to differences in spatial abiltiy, we assumed that these would reflect differential experiences in motor activity and the utilization of kinaesthetic cues. Differences in overall experience in motor activity and exploration of the spatial characteristics of the environment we assumed would reflect differential parental permissiveness for such activity and exploration. Studies of child rearing practices have shown that the degree of permissiveness in these areas is quite closely related to the parents' permissiveness for other aspects of impulse expression, including aggressive behavior. Although we were not measuring parental permissiveness directly, we assumed that as a common antecedent it would be similarly reflected in differences in spatial ability and differences in aggression. Specifically, we predicted:

Hypothesis 11. High-space children would be relatively aggressive.

Hypothesis 12. High-space children would be low in anxiety about aggression.

These hypotheses gained some additional plausibility from the frequent clinical observation that delinquents, who are usually high in anti-social aggression, do better on "performance" (i.e., spatial) than on verbal and numerical tasks measuring intellectual ability.

Our predictions about differences in aggression between high and low-number groups involved assumptions about the development of impulse control. The psychoanalytic description of ego-development relates the development of cognitive functions to a process of increasing capacity for delay between external and/or internal stimulation and motor discharge. Numerical ability is probably the most abstract (in Kagan's terminology, 1963, the most dependent on the "analytic" attitude) of the cognitive functions we are studying. Therefore, it should be most closely related to the capacity for inhibition of motor discharge and of impulse expression in general. Thus, we predicted that:

Hypothesis 13. High-number children should score high on measures of aggression-inhibition (anxiety about aggression), and low-number children should show less control of aggression and more manifestations of less acceptable forms of aggressive behavior.

We have no initial hypotheses as to differences in aggression between high and low-verbal groups.

Delay of gratification

As noted above, in psychoanalytic theory, ego development is held to be related to the growth of impulse control. Impulse control involves not only the ability to inhibit aggression and motor discharge, but also requires that a child not yield to immediate temptation if a larger gain will be forthcoming by waiting. We believed that mathematical thinking usually requires more impulse control than verbal or spatial thinking. And we therefore thought that our high-math children might be more able to defer an immediate small gratification in favor of a delayed greater one. We did not feel entirely confident of this prediction, however. Thinking back to the conditions which we believed foster verbal development (close interaction with parents and dependency upon them, with its attendant sensitivity to their approval and disapproval), these conditions ought to produce a well-socialized child whose ability to resist temptation would be great. We felt, however, that when a child is placed in a situation where he can maximize his own gain by refusing an immediate gratification, the issue is not one of pleasing his parents, nor one of avoiding wrong-doing, so that in psychoanalytic terms the thing that is required is "ego strength" rather than "super-ego strength" -- what is required is impulse control, a trait which we expected our high-math children to possess in greater degree than our other groups of children. Hence we predicted:

> Hypothesis 14. High-number children should score higher on a test of ability to postpone gratification than our other differential ability groups.

Masculinity-femininity

A study of sex-typing and its relation to patterns of abilities was undertaken as a master's thesis project by Roberta Oetzel. The hypotheses, review of the literature, description of procedures, and results are presented in Chapter 6.

Use of kinaesthetic cues

We believed that high-verbal children would have acquired their special ability in part through selective attention to auditory and visual cues: that the history of development of verbal skills in an individual involves his having been especially attentive to the language of others as spoken to him, and to the fairly detailed visual discriminations required for rapid reading. A high-space child, on the other hand, we thought might have acquired his ability largely through manipulation of objects, so that the "feel" of objects would be important, as would the use of the child's own body cues as a reference point in space. We predicted that our high-space children would be more skillful in the use of kinaesthetic cues than our other children, and that the high-verbal children would be the least so, especially in tasks in which visual or auditory cues were disrupted with kinaesthetic cues undisturbed.

We employed several tasks to test these hypotheses: one involved performance while the children were blind-folded, so that they had to rely upon kinaesthetic cues to make accurate movements in space. Another was the familiar mirror-drawing task. We reasoned that this task involved the disruption of visual cues while the kinaesthetic cues remain valid -- a situation which should favor individuals who habitually rely more upon kinaesthetic cues. And finally, we employed "delayed auditory feedback" -- a procedure in which an individual talks while hearing a slightly delayed "echo" of his own voice. We reasoned that the procedure disrupts a portion of the normal auditory cues employed in the organization of speech. That is, while the bone-conducted portion of these cues is unaffected, the ear-conducted portion is disrupted. And the movement-produced cues from the tongue, lips, and larynx are not disrupted by the procedure. We expected that people who customarily make considerable use of movement-produced cues would suffer less disruption of their speech than people who make less use of these cues but depend instead upon the auditory cues.

Our hypotheses were:

Hypothesis 14. High-space children will perform better than other children on mirror drawing, a blind-fold test of spatial localization, and on delayed auditory feedback.

Hypothesis 15. High-verbal children will perform least well on these three tasks.

Stimulus selection, susceptibility to distraction

Two of the three measures of the utilization of kinaesthetic cues which we proposed to use involved the disruption of normal cue patterns (mirror drawing, delayed auditory feedback). A subject's performance on such tasks might be determined by abilities other than skill in utilizing kinaesthetic cues. A subject's ability to respond selectively to one set of cues, not allowing himself to be distracted by normally-used cues that are irrelevant (or even misleading) for the present task, would certainly be importantly involved. We therefore felt it necessary to include a test of our subjects' ability to do just this: to shut out irrelevant, distracting stimulus elements. Our initial reason for doing this was to provide data which would assist us in interpreting the findings from our studies of mirror drawing and delayed auditory feedback -- to determine whether the superiority of any of our groups on these tasks could indeed by interpreted in terms of differential use of kinaesthetic cues. In addition, we were interested in our subjects' handling of distraction tasks in their own right. The ability to respond selectively to some elements of a stimulus situation, while withholding response to other elements, has been the focus of a substantial amount of recent research. "Field independence" (Witkin, 1954; Witkin, 1952) involves this ability, as does the "analytic attitude" referred to by Kagan (1963). Witkin's field-independent subjects characteristically do well in the Gottschaldt figures test, a test which has a high loading on Thurstone's spatial factor (Thurstone, 1944), so we might expect that our high-space subjects would do best in our distraction tests. But there were other considerations which might lead to a prediction that it would be our high-number people who would be best able to select one set of cues and "suppress" others. Our reasoning is a bit devious; we will expand on it and hopefully make it clearer in the discussion section which follows the presentation of our results. Here let us simply say briefly that we regarded the inhibition of response to irrelevant cues to be part of a more general capacity for delay between stimulation and motor discharge; that we assumed further that numerical thinking on the whole requires more of this capacity than either spatial or verbal thinking. We therefore predicted that:

> Hypothesis 16. High-number children would have their performance least disrupted by an input of distracting, irrelevant cues.

Gottschaldt figures

In our review of the literature, we did not cover the work on "cognitive styles," for we wished to confine ourselves to studies which dealt directly with three primary mental abilities: number, verbal, or space ability. As previously noted, the students of cognitive styles are attempting to study processes which underly primary mental abilities, and are not identical, nor even coordinate, with them. There is one point, however, at which the two kinds of dimensions appear to overlap, and this is in the sphere of spatial ability. Thurstone (1944), in his factor analysis of perceptual tasks, identified a factor of ability to form and hold a closure against distraction. The PMA space score had a high loading on this factor, as did Gottschaldt figures. The ability to deal quickly with the kind of test material that is employed to measure space ability, then, has a substantial component in common with the ability to solve embedded figures problems. Witkin has employed the embedded figures test (Gottschaldt) as one of the measures of "field independence," so that it is possible that there is an area of overlap between his dimension and our measure of space ability. When Witkin (1962) did a factor analysis of sub-test scores on the WISC and scores on his measures of field independence, he did not find the numerical tests were loaded on the same factors as the field independence measures; Bieri (1958), however, reported a substantial correlation between college students' performance on the mathematical section of the Scholastic Aptitude Test and their scores on a version of the Gottschaldt figures test, while the correlation between Gottschaldt scores and scores on the _verbal_ sections of the SAT were negligible.

Gardner et al. (1959), in their factor analytic studies of "cognitive controls," found that performance on the embedded figures test emerged as part of a cluster of abilities. The factorial structure of abilities was different for the two sexes: for women, the Gottschaldt figures test had a very high loading on a "field articulation" factor -- a factor which Gardner and his colleagues viewed as the ability to differentiate the visual stimulus field. For men, the Gottschaldt test did not assume as central a position in any factor as it did for women, but it did have a moderate loading on a "scanning" factor -- scanning being described as a tendency to do wide (as distinct from restricted) sampling of a stimulus field.

The Gottschaldt figures, then, have been a central test, related to both the primary mental abilities (space, and perhaps number also) and to cognitive style dimensions. We wished to know whether we could interpret any of our findings concerning our high-space group in terms of the Witkin or Gardner dimensions, and we administered a modified form of the Gottschaldt figures test to our subjects to provide a link between our study and the studies on cognitive styles. We did not, however, have any hypotheses concerning this test, other than to assume that it would be more highly related to spatial than to verbal ability.

Perception of ambiguous stimuli*

We wished to discover whether a child's high skill in a particular area of ability was accompanied by some degree of "perceptual sensitivity" to materials relevant to that skill. Postman et al. (1952), and Solomon and Howes (1951), have shown a relationship between an individual's values (as tested by the Allport-Vernon values scale) and his ability to perceive correctly certain value-relevant words when they are very briefly presented on a tachistoscope. Solomon and Howes showed that the superiority of subjects' perceptions for "preferred" material was a function of greater familiarity with these words than with words from other value areas. We may ask whether a child's greater facility with spatial materials, for example, means greater familiarity with such materials and a greater ability to perceive such materials accurately under conditions of "ambiguous" stimulation. Our first hypothesis is that such a relationship exists, and that high-number, high-space, and high-verbal children, respectively, will be most accurate at perceiving material which is relevant to their area of special skill.

There are other aspects of perceptual performance under conditions of low-grade stimulation which are of interest. Frenkel-Brunswik's and her colleagues have posited a personality dimension which they label

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*The work on perception of ambiguous figures was done by Geraldine Harvey, for a Master's thesis. This section and the later report of the methods and findings related to this dimension, represents a condensation and revision of her original report.

"intolerance of ambiguity" which they believe had certain implications for perceptual performance. Specifically, they would say that an individual with poor tolerance for ambiguity would jump to conclusions early in interpreting ambiguous material -- would guess as to its nature, and once having guessed, would not shift easily to a new interpretation of the stimulus material even with increasingly strong negative evidence. And furthermore, an individual with high intolerance of ambiguity, once having made an interpretation of the stimulus, would be likely to say that he was sure of his judgment, instead of attaching a probability value to his own statement. Which of our differential ability groups should be most able to tolerate ambiguity, and hence most able to shift judgments in response to additional information and "wait and see" before announcing that they were sure of what they saw? We can see grounds for making two different predictions. Some clinical workers have believed that people with high math abilities were "over-controlled," or "rigid," or "compulsive." If this were true, they should be intolerant of ambiguity. But, on the other hand, Bieri has shown that mathematical ability is more highly associated with performance on the embedded figures test than is verbal ability, and performance on this particular test requires the individual to break set (and ignore the configurational factors that produce an initial set), so that Bieri's finding suggests a greater flexibility in perceptual performance on the part of the high-math people, something that would not be consistent with a view that they are high in intolerance of ambiguity. We therefore do not make a prediction concerning which of our high-ability groups will be most prone to stick to wrong guesses once made, or which group will be able to defer judgment until better information is available. We will simply compare the groups in these respects to see which of the possibilities mentioned above is more consistent with our data.

Creativity

As a Master's thesis project, Helen L. Bee carried out a study of creativity ("divergent" ability) with the children selected for this study. She related creativity not only to patterns of convergent abilities, as revealed by the Primary Mental Abilities test, but also studied the relationships between creativity and the personality and perceptual-motor dimensions already discussed. The hypotheses, review of the literature, description of procedures, and results of her work are presented in Chapter 7 of the present report.

CHAPTER IV. PROCEDURE

The Selection of Cases

The initial round of testing

The purpose of our initial round of testing was to identify children with the following six types of differential abilities:

High-verbal, low-space
High-space, low-verbal
High-verbal, low-number
High-number, low-verbal
High-space, low-number
High-number, low-space

Our initial population consisted of all the fifth grade children in two public school systems in the San Francisco Bay area: Redwood City and San Carlos. A total of 1,214 children were tested, and these included all the children present in the classroom on testing days. Thus, our initial tests covered the universe of fifth grade children except for those absent for illness or other reasons.

During October and early November, 1960, we administered the Primary Mental Abilities Test for ages 7 - 11 (Form AH, published by Science Research Associates). We felt that this test would provide part of the information we needed to evaluate the verbal, numerical, and spatial abilities of the children, but we did not wish to rely upon it entirely. We felt that the PMA score on numerical ability, which is based exclusively on addition problems, represented too restricted a sampling of numerical ability. And the two PMA sub-tests for verbal ability (one a written vocabulary test and the other a picture vocabulary test) needed to be supplemented, we felt, with information on the child's ability to use words in a meaningful context. The PMA score on spatial ability is the least reliable of the PMA sub-tests, and we sought a means of increasing the reliability of our spatial scores by adding comparable test items which would have the effect of lengthening the PMA spatial sub-test.

The Redwood City schools maintained a testing program which involved administering the Iowa Achievement Test and the California Test of Mental Maturity to children during the winter of their fourth grade year. In San Carlos, the California Achievement Test and the CTMM were administered at the beginning of the fifth grade. We obtained the scores of all the fifth grade children on the relevant sections of these tests and combined them with our PMA sub-test scores to obtain total scores on verbal, numerical, and spatial ability. The combining was done according to the following system:

Verbal Score:	
Iowa or California Achievement score on reading comprehension	Weighted 1
PMA vocabulary (pictures plus written)	Weighted 1
Number Score:	
Iowa or California score on numerical reasoning and computation	Weighted 2
PMA number score	Weighted 1
Space Score:	
CTMM space sub-test	Weighted 1
PMA space sub-test	Weighted 1

We did not include in our final score the sub-tests from the Iowa and California tests which measured the so-called "language skills" (e.g., punctuation and spelling). The verbal tests which we did include from the Iowa and CAT batteries were tests of reading vocabulary and reading comprehension. On the numerical side, the CAT and Iowa tests had numerical sub-tests which covered both computation (a greater variety of such skills than the simple addition problems included in the PMA) and "numerical reasoning." We weighted these tests twice as heavily as the PMA numerical scores in computing our final score on number ability because we did not want our designation of high or low number ability to rest too greatly on skill in addition. In deriving our total score for spatial ability, we made use of one of the two spatial sub-tests of the CTMM. We did not use the one of those which required the child to distinguish between right and left hand, because of problems which had arisen in the original administration of the test. We did use the CTMM sub-test which involves matching geometric forms.

It will be noted that we have combined scores from what is ordinarily thought of as an "ability" test (the PMA) with scores from "achievement" tests. We do not see these tests as testing essentially different things. Ability tests are ordinarily distinguished from achievement tests on the basis of how the scores are used -- whether for prediction or for evaluation of the child's present status. Actually, either of the sets of tests we used could be used for either purpose. Both undoubtedly reflect in some degree the child's original "capacities," as well as the outcome of his training and experience in interaction with his capacities. It is for these reasons that we considered it legitimate to combine the two kinds of scores.

Table 4.1 shows the intercorrelations between the PMA sub-tests and the other test scores with which they were combined. It will be seen that there is greatest consistency in verbal tests. In the case of spatial tests, it is not surprising that the PMA space test correlates only moderately with the CTMM space sub-test -- both are fairly short tests. The correlations between PMA number scores and the number scores on the achievement tests are also in the middle range, and lower than the intercorrelations for verbal tests. This is probably due to the fact that the number achievement tests covered a wider range of number abilities than did the PMA number test.

In each instance, we combined scores on the basis of the standard deviations of the respective test distributions. Thus, in combining the CAT verbal score with the PMA verbal score, we computed the standard deviation of the two distributions, and multiplied the scores on one distribution by a constant which would match the two distributions to one another with respect to their dispersion. We then added the resulting scores. In the case of number, we performed the additional step of multiplying the matched scores from the Iowa or CAT number test by two. After obtaining a final total score for each child on verbal, space, and number abilities, we transformed these scores to standard scores. The intercorrelations among our final verbal, number, and space scores are shown in Table 4.2. They are shown separated for the two school systems, since different tests were used and they were administered at different times. It may be seen that verbal and number abilities are more closely related than is either of these with spatial ability.

Table 4.1. Correlations between PMA sub-tests and other measures of abilities (taken from the CAT, IAT, and CTMM).

	Boys	Girls
PMA verbal sub-test:		
Iowa Achievement Test, reading sub-test (Redwood City)	.33	.78
California Achievement Test, reading sub-test (San Carlos)	.83	.76
PMA space sub-test:		
CTMM, space test (Redwood City)	.29	.42
CTMM, space test (San Carlos)	.59	.46
PMA number sub-test:		
Iowa number sub-test (Redwood City)	.51	.50
California number sub-test (San Carlos)	.47	.42
Number of cases:		
Redwood City	390	392
San Carlos	136	158

Table 4.2. Correlations between total Verbal, Number, and Space scores for all children initially tested (N = 1,076).

Redwood City

	Verbal	**Space**	**Number**
Final verbal		.25	.56
Final space	.31		.34
Final number	.47	.36	

San Carlos

	Verbal	**Space**	**Number**
Final verbal		.40	.71
Final space	.40		.41
Final number	.62	.43	

For each school system, figures above the diagonal are for boys, those below for girls. "Final" means the combined score from PMA and the other tests routinely given by the school.

Selecting children with discrepant abilities

Our first problem was to decide how great a difference between standard scores on two different abilities a child would have to have before we would consider him a case of "discrepant" abilities. We wished to choose cut-off points which would give us the maximum differences we could get while still obtaining 10 boys and 10 girls in each of our six groups, after some expected losses due to matching or inability to obtain test scores from the child. A count of the number of cases which would emerge with different cut-off points revealed that some patterns of discrepant abilities were considerably more common than others in our initial population. When the cut-off point was set at approximately 1.5 standard score units, the "yield" for each of the six groups was as follows:

Group:	Boys	Girls
1. High-verbal, low-space	18	19
2. Low-verbal, high-space	33	19
3. High-verbal, low-number	12	5
4. High-number, low-verbal	12	10
5. High-space, low-number	18	10
5. Low-space, high-number	15	12

There were more boys than girls in five out of the six groups, and girls who combined high verbal facility with low number facility were very rare indeed -- a finding which was contrary to our expectations.

These sex differences in the frequency of occurrence of discrepant abilities are puzzling. Our first hypothesis was that verbal and number abilities might be more highly correlated for girls; if this were so, cases of discrepancy between the two abilities would be rarer than for boys. But as Table 4.2 shows, this is not the case. We suspect the problem lies in the means and dispersions of scores for the two sexes. The girls in our population obtained somewhat (significantly) higher scores in the number tests, on the average, than did the boys. Furthermore, in San Carlos (though not in Redwood City) the standard deviation of their scores was smaller on the tests of all three abilities. Thus, cases of girls at the extremely low end of the number distribution would be especially hard to find.

Our problem was whether to accept a discrepancy of less than 1.5 standard score units in order to get additional cases of group 3 girls. We feared that if we did so we might get too many cases of children whose discrepancies were simply due to unreliability of testing, and that it would be more difficult to establish differences in performance on the dependent variables we hoped to measure. We therefore elected to keep the 1.5 cut-off point, despite the low frequency of group 3 girls. The use of this division point means, for example, that if a child was one standard deviation above the general population mean in verbal ability, he had to be .5 standard deviations below the population mean in number ability before he would be selected as a high-verbal low-number case.

We next went through a series of steps to refine our groups. First we dropped out three children with total PMA scores below 125 -- we felt that below this point, the child would have difficulty handling the testing materials we wished to employ. Then we dropped out cases whose "high" ability was below the population median, and those whose "low" ability was above the population median. Thus, if a child's score on space was .5 standard scores above the population median and his number score 2.1 above, we did not include him as a "high-number, low-space" child even though his scores on these two dimensions did have a discrepancy of more than 1.5 points. Next we dropped out children who came from homes where a foreign language was spoken, for we did not want to study "low-verbal" children whose problem in handling verbal materials could be traced to bilingualism. Our hypotheses dealt with other factors.

We had initially hoped to make sure that the "third" ability would be clearly intermediate between a child's "high" and "low" ability scores. That is, if a child were high in number and low in space, we wanted his standard score in verbal ability to be between his scores in the other two areas, and no closer than .5 standard score units to his other scores. However, using this restriction in selecting cases reduced our least populated groups too greatly. We therefore simply attempted to make sure, on a group basis, that the average score for a given group's third ability would be intermediate between its high and low scores.

A related issue was to equate the groups as well as possible with respect to "general intelligence" -- and our best measure of this was the child's total score on the Primary Mental Abilities test. In the groups with the highest frequency of cases, we attempted to discard cases in such a way as to match the groups for total PMA scores. A good matching did not prove to be possible in all cases, considering the other restrictions already imposed in the selection process. Furthermore, the cases we lost at a later point in some instances weakened the PMA matching originally achieved. Table 4.3 describes the cases

Table 4.3. Comparison of discrepant ability groups: mean standard verbal, space, and number scores, and total mean PMA scores*.

BOYS

Group:	Mean standard score on: Verbal	Space	Number	Mean score, Total PMA	No. of cases
1. Hi V -- Lo S	4.77	2.37	4.06	186.7	11
2. Lo V -- Hi S	2.79	4.78	3.57	175.2	13
3. Hi V -- Lo N	4.34	3.30	2.63	173.8	11
4. Lo V -- Hi N	2.56	3.56	4.47	176.5	11
5. Hi S -- Lo N	3.16	4.45	2.31	165.9	12
6. Lo S -- Hi N	3.26	2.23	4.47	173.5	12

GIRLS

Group:	Mean standard score on: Verbal	Space	Number	Mean score, Total PMA	No. of cases
1. Hi V -- Lo S	4.52	2.15	3.61	175.2	14
2. Lo V -- Hi S	2.23	4.39	3.27	162.1	12
3. Hi V -- Lo N	4.50	3.12	2.99	178.8	4
4. Lo V -- Hi N	2.36	3.06	4.16	162.0	8
5. Hi S -- Lo N	2.98	4.21	2.18	154.4	9
6. Lo S -- Hi N	3.43	2.21	4.40	173.7	9

*In order to avoid working with negative numbers, we added a constant to our standard scores. That is, the standard scores derived from the tests of our initial large population of fifth graders did not have the mean set at zero, but rather at 3.2.

which were ultimately included in our intensive testing program, showing for each group the mean standard scores in the three ability areas and mean PMA scores.

It may be seen from Table 4.3 that in the groups involving contrasts between spatial ability and either verbal or number ability, it was possible to choose children whose "high" and "low" abilities differed by more than 2 standard deviations, on the average. For the groups involving a contrast between verbal and number abilities, however, the average discrepancy was somewhat less, although still, of course, greater than the 1.5 standard deviation units which had been set as the minimum discrepancy for selection. For most groups, we were quite successful in having the average "middle" ability score truly intermediate between the "high" and "low" scores. The primary exception is in the high-verbal, low-number girls, whose space scores are very little higher than their number scores. This group was the smallest group initially, so it was not possible to correct this situation by further discards. In our analysis, however, we will have to take into account that our group 3 girls are perhaps best described as being high in verbal ability and low in both number and space.

It may also be seen from Table 4.1 that the groups are not perfectly matched with respect to total PMA scores -- group 5 girls are low, and group 1 boys are high. For some of our analysis, then, it will be necessary to partial out "general intelligence" statistically before analyzing between-group differences in other variables.

Partialing out Total Primary Mental Abilities Scores

As mentioned above, we initially attempted to match our six discrepant ability groups with respect to their total scores on the Primary Mental Abilities test, which was our best measure of "total intelligence." We did not succeed altogether in maintaining this matching. Among the girls in our sample, the high-verbal girls had higher total PMA scores than the low-verbal girls, and the high-space girls had lower total PMA scores than their low-space counterparts. Among boys, there were no significant inter-group differences in total PMA scores, but there was a trend in the direction of the low-space boys having the highest average score. It is therefore necessary to inquire about each of our measures whether it correlates with total PMA score, and if it does, to devise a method of holding "total intelligence" constant when we compare our groups with respect to their scores on the measures in question. The question arises as to how high a correlation must be between PMA and a variable before it is necessary to hold PMA constant in our computations with that variable. We chose a correlation of .25 as our cut-off point; we felt that if PMA accounted for less than 5% of the variance in a score, it was not worthwhile holding it constant, and furthermore, with our sample size, a correlation of .25 is required to reach the .05 level of significance.

We partialed out the effect of total PMA in the following manner. We first determined the correlation of each of our measures with total PMA. Table 4.4 shows these correlations. For any variable which correlated .25 or more (for either sex) with total PMA, we assigned each child a new score based upon the deviation of his score from the average

Table 4.4. Correlations between personality and performance measures and Total Primary Mental Abilities scores.

	Boys	Girls
Self-administered personality scales		
Aggression anxiety	.39	-.02
Projected aggression	-.13	-.42
Dependency on adults, sick, alone	-.01	-.39
Total dependency on adults	-.01	-.38
Peer Nominations Inventory		
Total aggression	-.30	.01
Total dependency	-.32	-.11
Dependency on teacher	-.30	-.29
Attention-seeking	-.30	.07
Likeability	.44	.22
Mastery	.40	.27
Femininity	.40	.20
Performance tests		
Gottschaldt figures, total correct	.36	.44
Gottschaldt figures, proficiency	.24	.37
Gottschaldt figures, % score	.34	.33

score for his PMA group. In doing this, we first separated the sample by sex of child, and then each sex group into 7 PMA groups. For each of these groups we determined the average score on the variable in question. We then smoothed the resulting curve, to take out variations due to small numbers of cases in a PMA group. We then assigned each case a new score, reflecting the discrepancy of his raw score from the smoothed average of his PMA group. An individual might be, for example, ten points below the others with similar PMA scores on the PNI score for total dependency; he would then receive a score of minus ten. But in order to avoid working with negative numbers, we added constants, and set the means high enough so that there would be no negative scores. It should be emphasized that this process was carried out separately for boys and girls. This means that for our PMA-constant scores, between-sex comparisons are not valid, and when we wish to make sex comparison, we will use raw scores.

Table 4.4 lists the variables which were correlated .25 or more for either sex with total PMA, and shows the magnitude of the correlations. When the differential abilities groups are compared with respect to these variables, later in this report, the PMA-constant scores (rather than the raw scores) will be used.

Measurement of Dependency and Aggression

Peer Nominations Inventory

Item selection

This peer-rating inventory was designed to measure our subjects' characteristic interpersonal behavior in a number of areas, primarily aggression and dependency. It was adapted from the Peer Nominations Inventory, an instrument designed to measure the social adjustment of pre-adolescent boys, developed by C. L. Winder and J. S. Wiggins. (The construction of the PNI is described in the progress reports on USPHS Grant M-2745 dated May 31, 1959; Sept. 15, 1959, and August 31, 1960.) The original PNI includes five scales: Aggression, Dependency, Withdrawal, Depression, and Likeability. Our version includes the following scales: Aggression, Dependency, Withdrawal, Likeability, Mastery, and a Masculinity-Femininity scale. The construction of the Masculinity-Femininity scale will be described in Chapter VI. With the exception of one aggression, one dependency, and four likeability items, the item content is different from that of the original PNI. The latter was designed as a measure of maladjustment, and most of the items were selected initially to be symptomatic of deviant behavior. We wished to devise an instrument which would permit us to differentiate among more moderate and socially acceptable degrees of dependent, aggressive, and unsociable behavior in our subjects. We also dropped the Depression scale entirely and added the Mastery scale.

In order to select less deviant aggression, dependency and withdrawal items, we had recourse to the item-analysis information on the total pool of items out of which the final PNI scales were selected.

We selected 14 aggression, 12 dependency, and 5 withdrawal items which had, on the average, higher proportions of usage (lower difficulty levels) than those selected for the original PNI. The mean difficulty levels (proportion of subjects in the standardization population who received 1 or more nominations) of our aggression, dependency, and withdrawal items are .67, .69, and .63 respectively, as contrasted with .51, .53, and .44 for the corresponding PNI scales. We further altered the wording of several items in the direction of probably greater social acceptability, so these proportions are minimal estimates.

The aggression and dependency items were further rationally subdivided into: Anti-social aggression, Pro-social aggression, Dependency to Teacher, Dependency to Peers: Attention-Seeking and Dependency to Peers: Other. We hoped to obtain sub-scale scores for these various aspects of dependency and aggression. We added two pro-social aggression items to the two we already had. Four likeability items from the original PNI and one new one were used. The five mastery items were all constructed rationally. The list of items included in these eight groupings is as follows (The numbers correspond to order of administration.):

Aggression (anti-social)
4. He makes fun of people.
6. He has a quick temper.
16. He gets pretty rough sometimes.
19. He doesn't play fair sometimes.
21. He's a real good fighter.
24. He gets into arguments.
25. He likes to have things his own way.
29. He doesn't back down for anyone, anytime.
30. He sometimes kicks or hits people.
33. He sometimes yells at somebody.
46. He's always calling some people names.
56. He pushes when he's in line.

Aggression (pro-social)
8. He criticizes people quite a lot.
12. If someone makes a mistake, he laughs at it.
37. He's always telling people what they're supposed to do.
40. If someone gets in trouble, he thinks it's funny.

Dependency to teacher
15. He hangs around the teacher.
22. He wants very much to please the teacher.
36. He asks the teacher pretty much.

Dependency to peers: attention-seeking
14. He shows off to make kids like him.
35. He likes an audience all the time.
51. When he has everyone laughing at him, he is pleased.
59. He goofs off to get attention.

Dependency to peers: other
10. He gives you things for no particular reason.
17. He will come up to you and want help.
41. He wants friends.
44. He acts younger than he is.
54. When a lot of other kids do something, he'll do it.

Withdrawal
11. He doesn't enter into many things.
18. He's shy.
23. He doesn't take part much.
52. He just likes to play by himself.
57. He doesn't go out of his way to make friends.

Likeability
20. He's the kind of kid (girl) I like.
27. He's a good friend of mine.
34. He's a good sport.
42. He's a real nice guy (girl).
50. I like to be with him.

Mastery
7. He's good at getting things done.
43. He likes to try new things.
45. He doesn't get scared easily.
49. He often thinks up things that are fun to do.
55. He's sure of himself in most things.

Administration

The adapted PNI was administered to all fifth grade classes in Redwood City and San Carlos which contained one or more of the children in our sample. This amounted to 47 classess containing approximately 1,400 children. The same format was used as that for the original PNI, with the excaption that separate forms were used for boys and girls. Booklets were assembled with the items listed down the left-hand side of the page and the name of every boy (for Form B) or girl (for Form G) in the class listed across the top. Form B was distributed only to boys and Form G only to girls, so that children were always nominated by peers of their own sex. A sample page from the PNI booklet is reproduced in Appendix Ic.

The following instructions were read verbatim to the children after the forms were distributed:

> We have been having boys and girls describe things they do. Now we want to find out if children here do the same sort of things. So we have written down lots of things that boys and girls do. You can check which boys or girls in your class do these things. You just guess the best you can.
>
> On the papers you have you will see the names of all the boys or all the girls in your class. Look for your name. Now take your pencil or pen and draw a line straight down the paper below your name like this. Turn the page. Find your name again and draw a line down. Now turn to the next page and put a line below your name. Now turn to the last page. Find your name again. Put the line down the page below your name again.
>
> Now turn to the first page. See the number one. After the number one it says, "He or she's a good runner." Now look across the names. Who is a good runner? Put a check mark under the name. Who else is a good runner? Put a check mark under his or her name. Put a check mark under the name of every boy or girl who is a good runner.
>
> Now look at number two. After number two it says, "He or she's pretty short." Put a check mark under the name of every boy or girl who is pretty short. If any boy or girl is pretty short, put a check mark under their name.
>
> (Same for 3.)
>
> If you're not very sure about some of these - just guess the best you can. You can probably think of at least one or two boys or girls to check for each of these.

The examiner proceeded through all the items, reading each one aloud in the form: "Who makes fun of people?" etc., with a pause after each item long enough for the children to make their nominations (about 1/2 minute). An attempt was made to keep the class working together and encourage them to consider all the children listed. The time required to complete the inventory varied from class to class, but averaged about 40 minutes.

Scoring

The method of scoring used was based on the "intensity" scoring adopted by Winder and Wiggins, rather than their original dichotomous scoring procedure. A child's score on a given item is based on the proportion of judges (other children in the class of the same sex who filled out the inventory) who nominated him for that item. The score for each child on each item was obtained by calculating the percentage of the judges in the class who nominated him for that item. For convenience in machine computation, these percentage scores were converted to a 10-point single-digit IBM code, running from 0 to 9. (For this conversion, percentages were rounded to one place, with fives rounded upwards, with the exception that all scores from 85% to 100% were coded as 9.) The total score on a given scale was simply the sum of these coded scores. Thus, for instance, the possible range of scores on Anti-social aggression was 0 - 103 and on Mastery, 0 - 45.

Item analysis

Our first task was to determine the internal consistency of the sets of items comprising our scales. This would allow us to decide on the items to be included in our final scoring of the scales. For this purpose we subdivided our total sample of 1,400 cases in the following way. We assigned coded scores to all the children in the project sample and to every other alternate child. (This was done with the exception of those classrooms in which there was no child in the project sample of a given sex -- then all children of that sex were omitted.) We thus had scores for the 126 children in the project sample and somewhat less then half of the remaining children -- approximately 600. This sample of 600 was then further divided in half by selecting every alternate child, and one of the two resulting samples (N = 305) was used for the item analysis.

For each child, the coded score on each item and five summed scores were punched on IBM cards. The five sums were: Anti-social Aggression (12 items), Dependency on Peers (9 items, including "Attention-seeking" and "Other"), Withdrawal (5 items), Likeability (5 items), and Mastery (5 items). A complete intercorrelation matrix (Pearson product-moment coefficients) was obtained for the resulting 48 variables (43 items plus 5 sums).

To summarize the results of this item analysis, we found that all of the aggression items were highly intercorrelated. The median intercorrelation for the Anti-social Aggression items was .64, and the median correlation of Pro-social with Anti-social items was .62. It did not seem feasible, therefore, to maintain these two separate scales. We thus have a Total Aggression scale, consisting of 16 items. There were two items, however, 21 and 29, which behaved somewhat differently from the rest of the aggression items, in that they correlated less highly with Dependency, negatively with Withdrawal and positively with Mastery and Likeability. These two items seemed to represent a more socially approved-of form of aggression, and consequently we are also calculating a sub-score composed of these two "Good Fighter" items.

One of our Dependency on Teacher items (22) proved not to correlate with the rest of the dependency items and was dropped. Some re-grouping of the other dependency items was necessary, but there emerged three sub-groups of items corresponding to our three original categories, as well as a Total Dependency scale of 11 items. One Withdrawal item was dropped, reducing this scale to 4 items. The Likeability and the Mastery scales proved to have high internal consistency (median item intercorrelations of .69 and .50, respectively) and were retained in their original form. The final list of scales and items is as follows:

Aggression

1. Total Aggression

   Items 4, 6, 8, 12, 16, 19, 21, 24, 25, 29, 30, 33, 37, 40, 46, 56

2. Good Fighter (Sub-score)

   Items 21, 29

Dependency

3. Total Dependency

   Items 10, 14, 15, 17, 35, 36, 41, 44, 51, 54, 59

4. Dependency on Teacher (Sub-score)

   Items 15, 36

5. Attention-seeking (Sub-score)

   Items 14, 35, 44, 51, 54, 59

6. Dependency on Peers, other (Sub-score)

   Items 10, 17, 41

7. Withdrawal

   Items 11, 18, 23, 52

8. **Likeability**

Items 20, 27, 34, 42, 50

9. **Mastery**

Items 7, 43, 45, 49, 55

Reliability

The reliabilities of the final 9 PNI scales were computed separately for the project sample and the remaining half of scored non-sample cases. This group (N = 239) was designated the "normative sample" and was used to provide estimates of scale reliabilities, means, standard deviations, and intercorrelations free from whatever biases might have been involved in the selection of our project cases with discrepant abilities. The data on reliability are presented in Table 4.5. Reliability coefficients were computed from the sums of odd vs. even items, and the Spearman-Brown correction applied. The reliabilities obtained from the normative sample are satisfactory for all the scales except for the two dependency sub-scales which contain only 2 and 3 items. These two sub-scales also have low reliability for the project sample, and thus any group differences on these sub-scales must be interpreted with caution. The Withdrawal scale has quite high reliability (.78) in the normative sample, but the coefficient drops to .30 in the project sample. This scale contains only 4 items, and an inspection of the item intercorrelations for the project sample reveals a range from .36 to .73, with a median at .45. We would seem justified, therefore, in considering scores on this scale as reasonably stable.

Table 4.5. Means, standard deviations, and reliabilities on PNI scales: normative sample and differential abilities sample.

Normative Sample

Scale	No. of items	Boys N=136	Girls N=103	Total Group N=239	Reliability*
1. Total aggression	16	42.15 (29.58)	31.36 (25.84)	37.50 (28.53)	.97
2. Good fighter	2	5.04 (4.07)	3.39 (3.17)	4.33 (3.80)	.78
3. Total dependency	11	24.49 (12.41)	22.56 (11.02)	23.66 (11.87)	.86
4. Dependency on teacher	2	3.71 (2.96)	4.30 (3.32)	3.97 (3.13)	.48
5. Dependency on peers: attention-seeking	6	14.32 (9.70)	11.28 (8.03)	13.01 (9.15)	.69
6. Dependency on peers: other	3	6.46 (2.60)	6.98 (3.40)	6.68 (2.99)	.37
7. Withdrawal	4	6.93 (5.35)	7.13 (5.53)	7.02 (5.43)	.78
8. Likeability	5	16.63 (8.03)	17.96 (9.47)	17.20 (8.71)	.92
9. Mastery	5	13.83 (7.85)	13.83 (8.03)	13.83 (7.93)	.85

Differential Abilities Groups

Scale	No. of items	Boys N=70	Girls N=56	Total Group N=126	Reliability*
1. Total aggression	16	31.13 (22.81)	30.39 (25.36)	30.80 (23.98)	.95
2. Good fighter	2	4.10 (3.88)	3.38 (3.56)	3.78 (3.76)	.80
3. Total dependency	11	22.37 (13.15)	22.45 (11.70)	22.40 (12.52)	.88
4. Dependency on teacher	2	3.61 (3.09)	3.89 (2.76)	3.74 (2.95)	.27
5. Dependency on peers: attention-seeking	6	12.07 (9.92)	11.36 (7.45)	11.75 (8.91)	.69
6. Dependency on peers: other	3	6.69 (2.87)	7.20 (3.38)	6.91 (3.11)	.43
7. Withdrawal	4	6.56 (5.52)	8.41 (4.98)	7.38 (5.37)	.30
8. Likeability	5	19.13 (7.76)	18.96 (8.64)	19.06 (8.16)	.91
9. Mastery	5	15.00 (7.31)	14.39 (7.85)	14.73 (7.56)	.83

***Split-half reliability, odd vs. even items, corrected for attenuation by the Spearman-Brown formula. Figures in parentheses are standard deviations.**

Intercorrelations among the scales

The intercorrelations among the nine PNI scales for the normative sample and the project sample are presented in Tables 4.6 and 4.7. Separate matrices are given for boys and girls, as well as for both sexes combined. In the normative sample, the pattern of intercorrelations among the scales shows few sex differences. Mastery seems to be more closely related to Aggression in boys and to high Dependency on Peers and low Dependency on Teacher in girls. Most of the sex differences seem to involve the variable of Dependency on Peers, Other, which correlates with Likeability and Mastery and slightly with socially acceptable aggression in girls, whereas it correlates with Dependency on Teacher for boys. One might conclude that dependency on peers is both more socially desirable and more differentiated from dependency on adults for girls than it is for boys, but the low reliability of the scale suggests some reservations about such a conclusion.

For both sexes, there is a very high positive correlation between Aggression and Dependency. The correlations (.77 and .76) are almost identical with that found for boys with the original PNI (.79). It is clear that most of this relationship is contributed by the Attention-seeking group of items. Apparently our attempt to develop measures of less deviant forms of aggression and dependency was only moderately successful. Total Aggression is still mildly negatively related to Likeability in both sexes, although the "Good Fighter" sub-scale is slightly positive. Our Total Dependency score, however, is somewhat less highly negatively correlated with Likeability in boys than in the original inventory, and the correlation for girls is essentially 0. It is

Table 4.6. Intercorrelations among PNI scales: Normative Sample

Sexes Combined

Scale	2	3	4	5	6	7	8	9
1. Total aggression	.75	.77	.42	.85	.03	-.01	-.23	.22
2. Good fighter	--	.47	.14	.56	.01	-.28	.16	.50
3. Total dependency		--	.66	.93	.44	.22	-.15	.18
4. Dependency on teacher			--	.44	.20	.34	-.29	-.12
5. Attention-seeking				--	.17	.10	-.18	.22
6. Dep. on peers: other					--	.22	.26	.16
7. Withdrawal						--	-.30	-.37
8. Likeability							--	.68
9. Mastery								--

Boys Only

	2	3	4	5	6	7	8	9
1. Total aggression	.76	.77	.46	.84	.03	.01	-.22	.28
2. Good fighter	--	.47	.22	.55	-.04	-.30	.19	.58
3. Total dependency		--	.70	.95	.45	.24	-.20	.19
4. Dependency on teacher			--	.51	.30	.36	-.30	-.04
5. Attention-seeking				--	.21	.13	-.21	.24
6. Dep. on peers: other					--	.25	.14	.05
7. Withdrawal						--	-.39	-.40
8. Likeability							--	.69
9. Mastery								--

Girls Only

	2	3	4	5	6	7	8	9
1. Total aggression	.70	.76	.42	.85	.06	-.03	-.23	.13
2. Good fighter	--	.46	.09	.53	.14	-.25	.19	.43
3. Total dependency		--	.64	.91	.46	.20	-.07	.16
4. Dependency on teacher			--	.42	.10	.32	-.31	-.22
5. Attention-seeking				--	.17	.06	-.12	.19
6. Dep. on peers: other					--	.18	.36	.28
7. Withdrawal						--	-.20	-.34
8. Likeability							--	.69
9. Mastery								--

Table 4.7. Intercorrelations among PNI scales: Differential Abilities Sample.

Sexes Combined

Scale	2	3	4	5	6	7	8	9
1. Total aggression	.75	.72	.41	.77	.33	-.15	.07	.30
2. Good fighter	--	.41	.09	.48	.19	-.33	.34	.53
3. Total dependency		--	.72	.94	.64	.09	.10	.22
4. Dependency on teacher			--	.55	.40	.28	-.18	-.08
5. Attention-seeking				--	.41	-.04	.09	.25
6. Dep. on peers: other					--	.19	.31	.25
7. Withdrawal						--	-.35	-.36
8. Likeability							--	.73
9. Mastery								--

Boys Only

	2	3	4	5	6	7	8	9
1. Total aggression	.79	.68	.28	.74	.28	-.20	.10	.25
2. Good fighter	--	.35	-.01	.42	.19	-.32	.37	.46
3. Total dependency		--	.70	.95	.55	.11	.04	.10
4. Dependency on teacher			--	.51	.35	.39	-.25	-.16
5. Attention-seeking				--	.34	.00	.02	.11
6. Dep. on peers: other					--	.12	.38	.26
7. Withdrawal						--	-.46	-.40
8. Likeability							--	.78
9. Mastery								--

Girls Only

	2	3	4	5	6	7	8	9
1. Total aggression	.72	.78	.58	.84	.30	-.09	.04	.35
2. Good fighter	--	.51	.26	.60	.22	-.32	.30	.62
3. Total dependency		--	.77	.94	.75	.04	.18	.38
4. Dependency on teacher			--	.63	.48	.10	-.10	.05
5. Attention-seeking				--	.55	-.08	.20	.47
6. Dep. on peers: other					--	.25	.26	.25
7. Withdrawal						--	-.24	-.30
8. Likeability							--	.68
9. Mastery								--

clear that for both sexes, it is Dependency on Teacher which is the most undesirable form of dependency, whereas Dependency on Peers, Other, is judged by other children as desirable, particularly for girls. Withdrawal again seems to be undesirable, particularly for boys, but apparently we did succeed in selecting somewhat less extreme items. In this form of the PNI, Withdrawal does not correlate at all with Aggression and only with Dependency on Teacher among the dependency sub-scales (and therefore only slightly with Total Dependency). It would seem, then, that we have to some extent eliminated the "general deviancy" factor, but not the relationship between aggression and attention-seeking. This latter relationship, then, does not seem to be mainly an artifact of the use of extreme items.

The general similarity of the scale intercorrelations for the normative and project samples is quite encouraging, since it suggests that the PNI has quite stable properties across populations of subjects.

We have said that the attempt to measure less deviant forms of aggression and dependency was only moderately successful. The distribution of scores on Total Aggression is still markedly J-shaped for both sexes, with most of the subjects receiving low scores. This is also true for Total Dependency and the dependency sub-scales for boys, but not for girls. For girls, the distribution of scores on dependency is only slightly skewed towards the low end. This is true even though there is no overall sex difference in mean scores.

The only marked difference between our project sample and the normative sample on the PNI is in the level of aggression in boys, boys in the project sample being judged by their peers as considerably less aggressive. This difference will require further investigation.

Self-administered Personality Scales: Dependency

Scale construction

We defined dependency as a tendency to seek help, attention, or the physical presence of other people. Previous research has suggested that the tendency to do this might not be a unitary trait, but that an individual might be dependent under some stimulating conditions and not others. We therefore distinguished three categories of dependency, each representing a distinct set of stimulating conditions which might elicit a dependent response. We also considered that dependency might be manifest in different degrees toward different targets: that is, that some children might be dependent on adults primarily, others on peers. Unfortunately, it was not possible to produce scales which would reflect all the possible combinations of target by stimulating condition -- the measuring instrument would have become too long, or the scales too short. We developed five scales measuring various aspects of dependency, some focused on specific targets or stimulating conditions.

1. Dependency on adults, problem-solving. This scale was made up of items intended to reflect a tendency to seek help from adults when difficulty is encountered in solving a non-personal problem (e.g., with homework).
2. Dependency on adults when sick, alone, or afraid. This scale referred to dependent behavior that occurred when the child was subject to a situation normally arousing some degree of anxiety.
3. Dependency on peers, restore positive relations. This scale measures the tendency to attempt to restore interpersonal contact with peers when this contact is interrupted or jeopardized.

It might be considered a measure of the tendency to respond to "withdrawal of affection" from peers by "begging" for return of affection, instead of ignoring or withdrawing from the situation.

4. Sociability with peers. This is a scale intended to measure affiliative tendencies with peers -- both enjoying the company of age-mates and disliking being alone would be included in this scale. In the early phases of our work on this scale, we attempted to separate the child's attitude toward being alone from his attitude toward being with others, for we suspected that these might not be simple opposites of one another: that is, there might be children who enjoyed both company and solitude, and others who disliked being alone but were also not very comfortable in a group. In item analyses on pre-test populations we found, however, that we could not keep these dimensions separate reliably, and we therefore combined them into a single scale on sociability with peers.
5. Attention seeking. This scale included items on seeking attention both from adults and from peers. It could be considered a measure of the child's tendency to "show off."

We wanted to measure certain aspects of independent behavior independently of dependent behavior -- that is, we did not wish to assume that independent behavior was simply the opposite of dependent behavior. Beller's work (1955) indicates that these dimensions are not polar opposites, and this is so for a number of reasons. It sometimes happens, for example, that a child will make strong efforts to accomplish something without help (independent behavior) under the stimulus of dependency motivation (the desire for approval from parents). We selected one aspect of independent behavior -- "mastery" -- for separate measurement.

6. Mastery. This scale dealt with the tendency to persist in difficult tasks, to enjoy and seek accomplishment for its own sake. In some respects, it measures opposite tendencies to those covered in Scale 1, for to obtain a high score on Mastery a child would have to express a preference for solving problems by himself, rather than seeking help. But some of the mastery items do not pose this alternative; e.g., the child is asked whether he agrees or disagrees with the statement, "I would rather do something too hard than too easy," and he could choose the "too easy" alternative without having to choose to go to others for help.

Our hypotheses also required us to obtain measures of "dependency anxiety" -- i.e., the tendency to become anxious over dependent impulses. We reasoned that such anxiety would arise from having been punished for dependent behavior, and that one way to detect the existence of such anxiety would be to discover whether the child anticipated punishment for dependency. We also assumed that a child who was anxious about his own dependent responses would be made anxious when he observed dependent behavior in others, and that this anxiety would show itself in avoidance and/or derogation of other children showing dependency. And finally, we thought that a child who had a high level of dependency anxiety would go out of his way to avoid being in a dependent position, even when a dependent response might be the "normal" response in a situation and the non-dependent response a costly one in terms of time, money, or effort. We, therefore, constructed three scales, all intended to measure dependency anxiety:

7. Derogation of dependency in others.
8. Anticipation of punishment for dependency.
9. Avoidance of dependency at some cost.

In constructing these scales, our procedure was: (a) to write initial sets of items; (b) to administer them to a pre-test set of classes in a different school system than the one from which our sample groups were drawn; (c) to carry out an item analysis, correlating each item against total scores on the scale of which the item was a part; (d) to revise the scales, dropping some items, adding some new ones, revising some, in the light of the item analysis; (e) to administer the revised scales to still another pre-test population (in still a different school system); (f) to carry out another item analysis, on the basis of which items were selected for our final scales.

In the course of our pre-test and item analysis work, we found that we could not develop internally consistent scales for two of the variables we had originally set out to measure: attention seeking and avoidance of dependency at some cost. Consequently, our subsequent analysis of the dependency scales involves only seven scales. Table 4.8 describes these scales, giving a sample item from each, the number of items in each scale, and the split-half reliability. We scored each of the seven scales separately, and also computed for each child a summary score, adding the scores from the two scales on "Dependency on Adults" (one for problem-solving, one for being sick, alone, or afraid). This

Table 4.8. Sample items and reliability of self-administered dependency scales.

Scale	Examples of items	Number of items in scale	Split-half Reliability*	
Dependency on adults, problem-solving	You have moved into a new town and are going to a new school. When you go to the school, you can't find the room you are supposed to be in. What do you do? ____Find a teacher and ask her where to go. ____Keep on looking on your own.	5	-	.49
Dependency on adults, sick, alone, afraid	It is your first day at a summer camp, and you have been given some free time. Which would you rather do? ____Write a letter home. ____Take a look around the camp.	8	.53	
Dependency on peers: restore positive relations	Your friend seems annoyed at you, and you don't know why. What would you do? ____Do nothing, it will blow over. ____Ask him what you did, and apologize. ____Try and be especially nice for a few days.	10	.56	
Sociability with peers	I'm happiest when I'm alone (checked on a five-point scale from "strongly agree" to "strongly disagree" scored negatively for sociability).	10	.43	
Mastery	I'd rather get a regular allowance than earn my own money. (Checked on five-point agree-disagree scale, scored negatively for mastery.)	8	.60	

Table 4.8 (con'd). Sample items and reliability of self-administered dependency scales.

Scale	Examples of items	Number of items in scale	Split-half Reliability*
Derogation of dependency	It doesn't bother me when my mother holds my hand. (Scored negatively for derogation.) I get mad at myself when I cry. (Scored positively for derogation.)	8	.55
Anticipation of punishment for dependency	A mother and father are just leaving for the evening when their little boy says he can't find one of his toys that he wants to play with. What would the mother or father say? ____"We're just leaving. You'd better look some more yourself." ____"I'll help you look for it." A mother is talking on the telephone when a little boy runs in the door from school, calling, "I'm hungry, may I have something to eat?" What would the mother say? ____"I'll be right there." ____"Shhh -- can't you see I'm busy?"	10	.74

* These reliabilities have been corrected for test length by the Spearman-Brown formula. The first scale had too few items to permit computing split-half reliability.

summary score is called "Total Dependency on Adults."

It will be noted that the items were presented to the children in two different forms. Some were statements with which the child was asked to express agreement or disagreement, and he could check one of a series of five boxes marked "Strongly Agree," "Agree," "Not sure," "Disagree," "Strongly Disagree." The remaining items described a situation, and asked the child to select an alternative that best described what he would do, or what he thought would happen, in the situation.

In constructing the scales, the direction of items was balanced -- that is, for some items, a check of "Disagree" would indicate dependency, for other items a check of "Agree" would do so, so the "response-set" reflecting a general tendency to agree or disagree was controlled. The complete final forms which were used appear in Appendix I, a and b.

Reliability

Because of limitations in testing time, it was not possible to include a large number of items for each scale. It is not surprising, then, that the split-half reliability of these scales, each made up of only eight or ten items, is fairly low. Table 4.8 gives the reliabilities for each scale, and it is evident that these low reliabilities will attenuate the correlations of these scales with other variables, and will reduce the chances of obtaining significant differences between our differential abilities groups in their mean scores on these variables. Still, their reliability is sufficient to make it worthwhile to examine the data.

Intercorrelations among dependency scales

We expected that our two scales "derogation" and "anticipation of punishment for dependency" would constitute measures of the same underlying variable, namely, dependency anxiety. As may be seen in Table 4.9, the two scales are essentially uncorrelated. Can we select one of them as reflecting anxiety about dependency? We see that, among boys, derogation of dependency is associated with a relatively low level of dependency on both adults and peers, and the relationship is stronger than that between anticipation of punishment and low dependency. If we regard anxiety over dependency as a motive which will produce tendencies to avoid dependent behavior, then it would appear that, among boys, derogation is more indicative of dependency anxiety than is anticipation of punishment. But we are faced with puzzling sex differences. For girls, derogation of dependency in others is more closely associated with low scores on the mastery scale than with any other measure. This suggests the possibility that derogation, for them, is a defense against their own passivity. More evidence will be presented for this interpretation in the next section.

A child's tendency to take the initiative in restoring positive relations with friends when something has happened to disrupt these relations also appears to have different meaning for the two sexes. We had originally thought that this "restore" scale would be a measure of the amount of dependency upon peers. We reasoned that the extent to which a child would try to restore affectional relations with others would be a function of his degree of upset over the threat of withdrawal of affectional support from peers. We now think the scale measures not the amount of upset the child experiences in such a situation, but his technique for dealing with it, and we suggest that the children who are

Table 4.9. Intercorrelations among self-administered dependency scales. N=126

		Scale Number								
		1	2	3	4	5	6	7	8	
1. Dependency on adults, problem-solving			.08	.46	-.02	.22	.06	.13	.00	
2. Dependency on adults, sick, alone, afraid		.16		.92	.38	.07	.09	-.35	-.09	
3. Total dependency on adults		.63	.87		.32	.14	.10	-.27	-.11	
4. Dependency on peers, restore positive relations		-.12	.09	.08		-.04	.36	-.23	-.08	
5. Sociability with peers	GIRLS	-.03	.14	.09	.35		.10	.11	-.05	BOYS
6. Mastery		.05	.11	.12	.06	.04		-.01	-.16	
7. Derogation of dependency in others		-.19	-.10	-.17	-.08	-.07	-.34		.08	
8. Anticipation of punishment for dependency		-.18	.00	-.18	.04	.06	-.01	.08		

skillful achievers will be the ones who are most likely to take positive steps to solve the kind of interpersonal problem the items in this scale depict. We assume that sociability is a more salient area of achievement for girls than it is for boys, so that sociability correlates with the "restore" scale for girls, while mastery does so for boys.

Self-ratings on dependency compared to peer ratings

The Peer Nominations Inventory included several questions which related to the child's dependency on his teacher and on his peers. We now wish to inquire whether children who answered our dependency scale questions in the way which we thought indicated dependent tendencies were the same children who were selected by their peers as dependent.

Table 4.10 shows these correlations. They are generally very low, and it appears that the two kinds of measures are not measuring the same thing. There are some interesting things to be seen in the table, however. First, children who see themselves as sociable (who say they are happiest when in the company of friends, etc.) tend to be reported as sociable by their peers -- that is, they are seldom reported as withdrawn from social contact. This correspondence is higher for girls than boys. Another interesting point is that, among girls, it is the girls who are seen as most highly dependent by their peers who are most likely to express derogatory attitudes about dependency in others. One interpretation of this finding is that "derogation of dependency" may be, at least in girls, a projective phenomenon or more precisely, an instance of displacement, in which the self-blame that would otherwise attach to the child's own dependency is translated into righteous indignation over the dependency of others. An alternative explanation, one which we are

Table 4.10. Correlations between scores on self-administered dependency scales, and Peer Nominations Inventory Scores, Differential Abilities groups.

Self-administered dependency scale		Peer Nominations Inventory Total Dep.	Dep. on teacher	Dep. on peers, attention-seek.	Other Dep. on peers	Withdrawal	Mastery	Likeability
		23	24	25	26	27	29	28
		14	15	16	17		19	18
Dependency on adults problem-solving	B	.03	-.15	.07	.06	-.15	.20	.03
	G	.02	.05	-.04	.11	.11	-.08	-.04
Dependency on adults, sick, alone, afraid	B	-.14	-.18	-.09	-.13	-.16	.13	.01
	G	-.08	-.02	-.14	.03	-.09	-.17	.00
Total dependency on adults	B	-.11	-.22	-.06	-.09	-.22	.18	[illegible]
	G	-.01	.02	-.13	.08	.01	-.18	.00
Dependency on peers: restore positive relations	B	-.29	-.21	-.32	.00	-.05	.28	.15
	G	.07	.15	.04	.02	-.25	-.05	-.04
Sociability with peers	B	.06	.08	.11	-.22	-.15	-.08	-.15
	G	-.04	-.05	.06	-.24	-.42	.01	.07
Mastery	B	.01	.05	-.12	.39	-.09	.22	.31
	G	-.20	-.27	-.17	-.08	-.13	.10	-.01
Derogation of dependency in others	B	.08	.08	.04	.13	.05	-.14	-.07
	G	.35	.39	.34	.13	.00	.02	-.06
Anticipation of punishment for dependency	B	-.02	-.09	-.02	.05	.00	.14	.10
	G	-.02	-.05	.03	-.10	-.06	.00	.10

reluctant to embrace, is that girls are made more anxious by their own dependent impulses than are boys. It appears to us unlikely that this should be so, since dependent behavior is more socially acceptable in girls than boys, and boys should therefore have more anxiety about it. And indeed, when we compare the means of the two sexes on our dependency scales, we do find that boys are more given to derogation of dependency than are girls (See Table 5.1). Yet, this derogation does not correlate with their *own* level of dependency for boys, while it does for girls.

Self-administered Personality Scales: Aggression

We measured our subjects' aggressive tendencies in two ways. One of these was through Peer Nominations, and this measuring device has been described above. Our second source of information concerning aggression was from a set of aggression scales developed by R. R. Sears, and described in a recent publication (Sears, 1961). Sears originally set out to measure the following aspects of aggression: aggression anxiety, projected aggression, pro-social aggression, anti-social aggression, and self-aggression. A factor analysis of the items revealed three factors: aggression anxiety, anti-social aggression, and projected aggression. Self-aggression did not emerge as a separate dimension, nor did pro-social aggression -- the items on this latter scale usually having heavy loadings on the aggression anxiety factor. In the present study, nearly all the items Sears had used in his factor analysis were included. We scored only those items which had loadings on one of Sears' three factors, and gave each child three scores, one for each factor. Unfortunately, for these scores, response set is *not* controlled. The items were prepared in the form of simple sentences with which the subject was asked to express his agreement or disagreement. He checked a five-point scale ranging from "Strongly Agree" to "Strongly Disagree." For example, the statement, "It makes me uncomfortable to see two of my friends fighting," was part of the aggression anxiety scale, and the child would received a plus score on the scale if he marked "Agree." For 14 out of the 15 aggression anxiety items we used, a check of "Agree" would indicate possession of the trait; for only one of them was a "Disagree" answer indicative of aggression anxiety. Similarly, for 9 out of 10 of the projected aggression items, an "Agree" answer is scored positively. We had only 5 items on anti-social aggression, and all five of these were scored in the same direction. Consequently, an acquiescent response set would tend to produce high scores on all three of these scales. The fact that the scales do not uniformly correlate positively with one another, however, indicates that even if response set is at work, there is a major portion of the variance of the scores being contributed by factors specific to the individual scales. That is, for example, there is a significant negative correlation between aggression anxiety and anti-social aggression, as measured by the two factor scales, despite the fact that response set would lead a subject to obtain high scores on both scales. We have reason to believe, then, that the two scales are measuring something independent of response set, and independent of one another. As may be seen from Table 4.11, projected aggression is independent of aggression anxiety, and slightly positively related to anti-social aggression.

Table 4.11. Intercorrelations among the aggression factor scales (self-administered): Differential Abilities Groups.

	Aggression anxiety	Anti-social aggression	Projected aggression
Aggression anxiety		-.25	-.03
Anti-social aggression	-.39		.26
Projected aggression	.03	.16	

Figures for boys are above the diagonal; those for girls below.

Atble 4.12. Correlations between self-administered aggression scales and PNI aggression scales: Differential Abilities Groups.

	Peer Nominations Inventory scores			
	Total aggression		"Good fighter" (sub-score)	
Factor scales:	Boys	Girls	Boys	Girls
Aggression anxiety	-.33	-.22	-.13	-.28
Anti-social aggression	.30	.10	.19	.17
Projected aggression	-.05	-.06	-.16	-.07

Self-ratings on aggression compared to peer ratings

As mentioned earlier, we have information concerning the children's aggressive tendencies from both peer ratings and the self-administered scales just described. We may ask how much correspondence there is between these two sets of measures. The Peer Nominations Inventory provided two scores on aggression: a "total aggression" score, and a sub-score of two items taken from the larger group of aggression items which measured a more socially-approved aspect of aggression: the "good fighter" sub-scale. Table 4.12 shows the correlations between these scales and the Sears factor scales. For boys, the correlation between anti-social aggression on the factor scale and PNI total aggression is significantly positive (though small), and as might be expected, the scores on aggression anxiety correlates negatively with aggression as seen by classmates. For girls, the relationships are in the same direction, but smaller. It is evident from these figures that the two kinds of measures are measuring the same thing to only a moderate degree. Reasons for the low correlations may be (1) the relatively low reliability of the self-report aggression scales; (2) the fact that aggressive "feelings" (as revealed in the self-report measure) may not always find direct overt expression in ways that peers can report. The correlation between the "impulse" and overt behavior would depend, among other things, on the extent to which aggression has been punished (Lesser, 1957).

Selective Attention to Interpersonal Cues

Recall of interpersonal content from a motion picture

We had two methods of measuring our subjects' sensitivity to interpersonal cues. The first was a test for their recall of the content of a movie, and the children were separately tested for their recall of interpersonal versus non-interpersonal content in the scenes they had viewed. In previous work (Maccoby & Wilson, 1957), differential recall of movie content had proved to be a significant indicator of certain differential dispositions among viewers, and we therefore adapted this technique to our present purposes. The second method was to administer the "stick figures" test, previously used by Sarbin and Hardyck. We will first describe the test based upon the movie.

The movie we chose was Walt Disney's Toby Tyler, a film in color which told the story of a boy who ran away from the farm of his cruel uncle to join the circus. We obtained a 16 mm. print of the film, and showed it to our subjects in groups of approximately 30, bringing together children from neighboring schools for showing. Immediately after seeing the film, the children were given a test on the content of the film. Some of the questions were multiple choice, some required the child to fill in a brief description or list of items from memory.* We identified the items in the test in terms of whether or not they dealt with interpersonal material. Examples of items of each kind follow:

Interpersonal

1. What did Uncle Daniel say that made Toby cry?
(Answer to be written in)

2. Ajax was teasing Toby. What did Ajax say?

____"I bet you've never been on a horse in your life."

____"Here comes old peanut pants."

____"Here's the death-defying dare-devil of the lemonade stands"

____"How come Mr. Tupper let you out?"

---

* Previous work with recall of film content as a way of measuring differential dispositions of viewers had shown that recall items were better discriminators than recognition items (See Maccoby & Wilson, 1957).

Non-interpersonal (called stimulus items)

1. What were the circus people having for breakfast? (Answer to be written in)
2. What did the prisoners in the jail keep water in?

_____a blue, barrel-shaped crock

_____a blue pitcher

_____a brown bottle

_____a tin pitcher

The test included 43 items, of which 24 were interpersonal, the remainder stimulus. In scoring the tests, one point was given for the correct choice in the multiple choice items. For the write-in items, points were given for the number of correct elements recalled. Scorers developed a key listing possible answers, with agreed-upon point credit to be given to each. Twenty cases were selected for determining the reliability of scoring. Two scorers independently scored the write-in questions for these cases; there were 24 write-in questions, so the number of answers re-scored was 480. There was complete agreement in the numerical score assigned to an answer in 91% of these instances. Having obtained total scores for the interpersonal items, and a separate score for the stimulus items, we computed a difference score with the formula I minus S plus 14 (the constant being added to eliminate minus scores). Thus, a high scorer on our difference score had better recall of interpersonal than non-interpersonal material.

Reliability, Toby Tyler scores

We computed the split-half reliability of the scores based upon the Toby Tyler test, and they are low:

	Uncorrected reliability	Corrected (Spearman-Brown)
Interpersonal items	.38	.55
Stimulus items	.34	.51

As might be expected, scores on both kinds of material were significantly correlated with the child's total intelligence, as reflected in his total PMA score. But the difference score was not correlated with total PMA, and it is this score which bears most closely upon our hypotheses. We shall therefore use it exclusively in our analysis of group differences.

Stick figures procedure

Our other measure of sensitivity to interpersonal cues was the Stick Figures Test. This is an instrument developed by Hardyck and used by Sarbin and Hardyck (1953) as a measure of role perception from postural cues, or empathy. The test consists of a series of 43 cartoon-like line drawings of human figures in various positions. For this study we used a film strip, projecting the drawings one at a time for about 10 seconds each. The subjects were told to look at each drawing and then select from among three adjectives on the answer sheet the one which best described it. The exact instructions as well as the alternatives for each item are shown in Appendix Id. This three-choice answer form was adapted from one used by Sarbin in a study of adolescent delinquents. After some initial pre-testing a few of the adjectives were changed to ones more appropriate to the vocabulary level of our subjects. The Stick Figures were administered to small groups of the sample children, in the same session as the Gottschaldt figures.

Four scores were obtained: the communality score, the inferential score, the descriptive score, and a difference score between the latter two (i - d). The communality score is a measure of the degree to which a subject's choices of adjectives to describe the figures agree with those generally chosen. In order to obtain appropriate norms, we administered the Stick Figures to 150 boys and 153 girls in fifth grade classes in San Mateo. We assumed that this was an equivalent population to that from which our sample was drawn. In Appendix I are listed the percentages of boys and girls in this normative sample who chose each of the alternatives for each item. These percentages were used to make up the communality scoring key, simply assigning to each alternative a one-digit code representing the percentage of the normative sample selecting that alternative, rounded off to the first decimal. Thus a subject who chose "thinking" to describe the first figure would get a score of 7 and one who chose "resting" would get a score of 1. The subject's communality score was the sum of the scores for all items. The raw scores ranged from 193 - 258. They were punched as a two-digit code after subtracting a constant of 190. The odd-even reliability of the communality score, corrected for attenuation, was .117.

The inferential and descriptive scores were derived by categorizing each adjective in the list as either inf., desc., or indeterminate. Only those items were scored which had both an inferential and a descriptive alternative. "Inferential" adjectives were those which referred to the internal state, feelings, state of mind of the figure. "Descriptive" adjectives referred to observal external characteristics, what the figure was "doing." The two investigators were able to make this categorization with almost perfect agreement. The i score was simply the number of inferential alternatives selected, the d score the number of descriptive words chosen. The difference score, i - d, was also coded, after adding a constant of 10. Odd-even reliability for i - d was .195. In the total group, the communality score is correlated -.29 and .20 with inferential and descriptive respectively. In view of the very low reliability figures, the usefulness of these measures is questionable.

Delay of Gratification

To measure our subjects' ability to postpone gratification, we employed a version of the candy test developed by Mischel (1958). We pretested a variety of kinds of candy, sizes of pieces, and lengths of delay, in an effort to find the combination which would yield about 50% immediate and 50% delayed choices. We settled on the following procedure. First we showed the child five standard-sized candy bars, each of a different variety. The experimenter said:

> "I have here five different kinds of candy. Which kind do you like best? (Child chooses) O.K. You can have a small piece of this candy (showing small piece of chosen candy) right now, or you can have this larger piece day after tomorrow when we come back. Which would you like?" (If the child takes the smaller piece) "I want you either to eat it right now or wait until after school, so you won't be eating during class. O.K.?"

The experimenter placed the large and small pieces of the chosen variety of candy the same distance from the subject which he was making his choice. When the child was initially tested on Friday, the experimenter could not, of course, come back "day after tomorrow," but returned with the large candy bars on Monday.

Utilization of Kinaesthetic Cues

Blindfold Test

A 10-foot square area with the corners marked by X's was set off in a classroom, or on the school playground. S was told, "This is to see what kind of a sense of direction you have." On three separate tests S was required to walk (while blindfolded) from one corner of the square to another corner at 90° or 180° to the corner he was facing. Before each test S was shown the corner he would be facing when he started as well as the corner he was to walk to. The steps of the procedure were as follows: S was blindfolded, turned around by E, faced toward a designated corner, then directed to walk toward another corner of the square, and stop when he believed he had reached that corner. E then removed the blindfold and marked S's location on a prepared record sheet while S remained at his stopping point. The starting point, direction S faced, and the point toward which S was to walk on each trial are indicated in the following table:

Trial	Start	Face	Finish
1	Bot. L	Top L	Bot. R
2	Bot. L	Bot. R	Top L
3	Bot. L	Directly away from Bot.R	Bot. R

Scoring

Two types of errors were measured: distance errors and angle errors. For each trial the standard scores for the S's distance errors were computed (mean 5, standard deviation 1); these scores were summed to obtain a Sum Error Standard Score. Standard scores were similarly computed for the angle errors and summed to obtain a Sum Angle Standard Score. A Total Error Score representing the sum of the 6 standard scores described above was obtained. A Total Improvement Score was also computed to represent the changes in total error scores between trials 1 and 2, and 2 and 3. (Sum of the differences in total error scores between trials 1 and 2, and trials 2 and 3.)

Reliability, blindfold test

Although there was a certain amount of subjective judgment in the scoring of distance and angle errors, a check of inter-rater agreement revealed that there was little problem of reliability of scoring: the agreement was satisfactorily high. But one may ask the question about reliability in another way: namely, what is the inter-trial correlation for each of the two kinds of errors? We computed the average inter-trial correlation for distance and angle errors separately, and they are:

Distance errors:	.138
Angle errors:	.509

We see that performance on the blindfold test is not a very consistent phenomenon from trial to trial, but that the direction in which the individual moves is a more stable segment of his performance than the total distance he moves.

Mirror drawing test

This procedure used an apparatus obtained commercially from the Lafayette Instrument Company. The subject's task was to draw a line connecting a series of asterisks placed approximately 1/2-inch apart and outlining a large star.

The mirror drawing apparatus was arranged so that the mirror was at right angles to the area on which S was to draw, and the top of S's record sheet was directly between the mirror supports. S started drawing from the bottom of the star, moving his pen through the asterisks forming the outline of the star in a clockwise direction (Left-handed S's drew in a counterclockwise direction.). The following directions were given to S: "Now the way this is set up you cannot see your hand except in the mirror. I want you to mark the outline of the star, passing your line through all the little stars." If S started to move his pen backwards, E said, "That's all right -- just go on ahead, you don't need to go back." Three minutes were allowed for each of 2 trials.

Scoring

Four scores were obtained as the basic measures of S;s performance. 1) Errors: (deviations of S's lines from straight lines joining the segments of the star. For each segment a score was assigned indicating the maximation deviation within that segment); 2) Number of segments attempted within the allotted time; 3) Number of asterisks touched; 4) Time in seconds. These scores were computed for each trial and converted to standard scores based on the total distribution of scores for the 2 trials.

Five scores were derived from these 4 basic scores for use in the analysis of the data:

1. Rate: Number of segments attempted, divided by total time, trials 1 and 2 combined.
2. Accuracy: Number of asterisks touched, divided by the number of segments attempted, trials 1 and 2 combined.

3. Error: Total error score divided by the number of segments attempted, trials 1 and 2 combined.

4. Total Performance: Rate (1 above) plus accuracy (2 above) minus error (3 above). For this score, the three component scores were standardized before combination and the scores for the two trials were added.

5. Improvement: The difference between total performance score (as defined under 4 above) for trials 1 and 2.

Mirror drawing, reliability

The reliability of the three basic scores on the mirror drawing task was assessed by calculating, for each of them, the correlation between the first and the second trial. This is, thus, a measure of the consistency of our subjects' performance on this task. The three correlations are: Rate: .65; Error: .74; and Accuracy: .44. Apparently performance on this task is moderately stable from one trial to another. Since the scoring was completely objective, no inter-scorer reliability was calculated.

Delayed auditory feedback, procedure

We added a delay circuit to a standard Magnecord tape recorder. The delay circuit was modeled on the one described by Fairbanks and Jaeger (1951). During the delayed feedback tests, the subjects wore a set of headphones, to which a microphone was attached. For each subject, the apparatus was set so that the microphone was 2 inches from his mouth. The microphone picked up the subject's speech, and the speech signal was then recorded on tape. The tape ran across a tape-delay unit, and after an interval of .3 seconds the signal was played into the subject's headphones, so that he heard an "echo" of his own voice as he spoke. The intensity of the feedback signal in the earphones was 92 db.

Each subject was first asked if he could remember the Salute to the Flag, and was asked to say it. If he needed help, he was prompted, and if he rushed through it so rapidly that it was difficult to distinguish words, he was asked to slow down. Then the headphones were set in place, and the child said the "salute" through two more times, once with his voice being recorded and no delayed signal, and the second time with his voice being recorded as he spoke while hearing the "echo" in the earphones. The instructions were as follows:

> I am going to put the earphones over your ears and a microphone in front of your mouth. Then I will ask you to say the Salute to the Flag. The first time you say it, you won't hear anything in the earphones. After you've said it through once, I'll ask you to say it again and this time as you say it, you will hear an echo of your own voice. The microphone will pick up what you say and this machine will play it back into the earphones so that you will hear an echo of your own voice. It's a hard thing to keep on talking when you hear the echo, but do the best you can, and try to keep right on saying the pledge to the flag no matter what you hear in the earphones. O.K.?

Our taped record of each child, then, permitted us to compare his performance under standard conditions (while wearing earphones but not hearing anything on them) with his performance under delayed feedback.

Scoring

We computed four basic scores for each child:

1. Total errors in articulation, standard condition
2. Total errors in articulation, delayed feedback condition
3. Total time required to complete saying the "Salute," standard condition
4. Total time, delayed feedback condition

The unit used for tallying errors was the number of words containing at least one error. That is, if there were two errors in one word, it was counted as only one error. Each subject served as his own control for errors, so that the same error committed in both the standard and the delay conditions was not counted as an error. For example, it was fairly common for a child to slur his words so that "United States" was pronounced "Unied States." If the child did this under both conditions we regarded this as an articulation defect which was part of his ordinary speech and which was probably unrelated to our experimental conditions. There were, of course, many instances in which a child articulated a word properly under standard conditions and misarticulated under delayed feedback; this misarticulation would be counted as an error. Also, there were instances in which a child misarticulated under standard conditions and pronounced the word correctly under delayed feedback. This change could be due to either variability in a child's normal speech, or a deliberate effort to achieve good speech in the face of the obstacles presented by the delay condition. In the latter case, it would be due to our experimental conditions, and we therefore counted it as an error. The types of errors counted were as follows:

Insertions	For each insertion of audible material, regardless of type or amount, the error count was increased by one.
Repetitions	Any re-articulation of any part of an utterance, from the level of the phoneme or larger, was considered to be a repetition. Under delay conditions, a repetition frequently occurred on the last syllable of the word America.
Omissions	Omissions were also judged from the level of the phoneme up to the level of words and phrases. Each word omitted was counted as an error word.

Substitutions	An error was counted for each instance in which one phoneme was substituted for another within a word. Example: "I pleg allegiance."
Distortions	Single-sound errors which could not be clear perceived as substitutions yet were outside the boundaries of acceptable allophonic variation for the subject were scored as distortion errors. Distortions occurred almost exclusively on the sound "el."
Prolongation	These errors were marked whenever a phoneme was sustained for a period of sufficient length to be perceived as an abnormal variation in relation to the preceding articulation pattern. The vowels in the words "flag," "God," and "America" were quite often prolonged under the delay condition.
Promptings	If a subject stopped entirely during recitation, the experimenter prompted him. Promptings occurring in the undelayed condition were not counted as errors. Promptings in the delay condition not corresponding to promptings in the undelayed condition were counted as one error. If the prompting caused the subject to repeat words previously uttered, these words were not counted as errors regardless of their production.

Several tapes were scored and discussed by two raters, and on the basis of these discussions the raters agreed on scoring criteria. The remaining tapes were then scored independently by the two raters, and the inter-rater reliability of the total error scores was .95.

In order to obtain a measure of the degree of disruption in the subject's speech as a result of the delayed feedback condition, the following transformations and combinations of scores were performed. We computed a change-score for errors (errors under delay minus errors under standard conditions), and converted these change scores to standard scores. We then computed a change score for time (time under delay minus time under standard conditions), and converted these scores to standard scores. Each subject's score for "total disruption" was his standard score for error change plus his standard score for time change. This total measure took into account the fact that some subjects "trade" time for errors: that is, under the delay condition, they manage to articulate reasonably well but they slow down considerably; others maintain their normal rate of speaking (or nearly so), but make many errors in articulation. Both patterns reflect disruption due to the delay condition.

We computed another score called the "deterioration" score, to reflect whether the subject's performance improved during the delay condition or whether there was progressively greater disruption throughout the recital of the "Salute." We derived the total disruption score described above separately for the first part of the "Salute" (through "and to the Republic for which it stands"), and for the second segment. The disruption score for the first segment was subtracted from that of the final segment in order to obtain a measure of deterioration.

Distraction

We used four different measures of susceptibility to distraction, varied as to the nature of the task, the distracting stimulus, and the conditions of presentation (simultaneous or successive). "Susceptibility to distraction" is defined as the decrement in performance on a given task shown by the subject when a distracting stimulus is introduced. The measure is always a difference score, comparing performance under distraction with performance in a baseline, non-distraction condition. We used two kinds of tasks, verbal and numerical, on the assumption that our subjects might show disruption on tasks which they ordinarily performed less well. We expected that these effects would cancel each other out for our low-verbal and low-number children, and thus that the over-all measure of susceptibility to distraction would be equally useful for comparing high versus low-verbal and high versus low-numerical groups. The content of the distracting stimulus corresponded to the nature of the task, since one would expect interference effects to be greater where task and distractor are similar. We used a numerical distractor with the number tasks and a verbal distractor with the verbal tasks. Both were, in a sense, interpersonal and were presented auditorily -- the child heard a woman's voice reading multiplication tables or a story. Each kind of task was presented under two conditions -- simultaneous and successive. The successive condition involved a brief period of delay between the initiation and completion of each numerical or verbal problem, thus introducing an element of memory into the task. We expected more interference from the distractor in the successive than in the simultaneous condition, and thus a more sensitive measure of susceptibility to distraction. The order of the distraction tests was as follows:

1. Verbal Distraction (i.e., verbal task, verbal distractor) Simultaneous

2.	Verbal Distraction (i.e., verbal task, verbal distractor)	Successive
3.	Numerical Distraction (i.e., number task, numerical distractor)	Simultaneous
4.	Numerical Distraction (i.e., number task, numerical distractor)	Successive

Each of the four tests included a baseline and a distraction condition.

Procedure, distraction tests

The *Verbal Distraction* tests were administered individually at the beginning of a testing session which also included Delayed Auditory Feedback. Equipment for the distraction procedure consisted of pencils, stopwatch, three answer forms to be used by the subject, a set of 12 slides containing the stimulus words for the Successive condition, a portable slide projector fitted with a manually operated shutter, a screen, a Wallensak portable tape recorder, a set of earphones, and a tape containing the distracting stimulus (a portion of a moderately exciting story from a fifth grade reader chosen so as to be unfamiliar to the children). The task for both parts of the Verbal Distraction was that of finding the opposites of a series of words from a number of multiple-choice alternatives. (See the forms reproduced in Appendix If.) The words were selected from the Thorndike-Lorge lists so as to be at about fourth grade reading level. The lists used in the various conditions were equated for average frequency of usage, although since we were comparing each child with himself this was not a crucial control.

The child was given the following general introduction:

> Johnny Brown? Hi! I am one of the people from Stanford University. Today we want to try something new. Today we're going to see how well you can keep your mind on your work when there is talking going on. Have you ever tried to study when people were talking? Well, then you know what it's like.

The subject was then given Form A for the Simultaneous condition (See Appendix If) with the following instructions:

> I have some words here. Look at a word here, and then look for its opposite over here. When you find the opposite, draw a circle around it. Try this one. Good. Here is a set of words like the one you just did. There are two pages of them. Do not turn them over until I tell you to. I am going to put these earphones over your ears. As you work this first set you won't hear anything on the earphones. A little later on you will hear a voice. I am going to see how many you can do in two minutes. When I say "start" turn over your page and begin.

The child was allowed 1-3/4 minutes to complete Form A. The headphones were put on at the beginning so that whatever disturbance they might produce would be constant throughout the procedure. At the end of the time allowed, Form A was removed and the child was given Form B with the following instructions:

> Here's another set of words just like the first one. While you work this second set you will hear a voice in the earphones. Try not to pay any attention to this voice and go ahead the best you can to find the opposites just as you did before. First you'll hear the voice. When I say "start" you can begin.

Again the time allowed was 1-3/4 minutes.

Verbal Distraction - Successive followed immediately after the simultaneous condition. In this task groups of four words were projected for a brief period on the screen and then removed before the child looked at the list in which he was supposed to locate their opposites. The list for each group of words was printed on a separate page of the answer booklet (See Appendix If). The instructions were as follows:

> Now I am going to flash on that screen a set of four words. You are supposed to look at them and keep them in mind. Then I will turn them off. When I lower my arm like this (E drops arm within the child's field of vision as he looks at the screen) turn your page and find their opposites. Draw a circle around the four words which are opposite to the ones you saw on the screen. For a while you won't hear anything on the earphones.

The first six slides constituted the baseline condition. Each slide was exposed for four seconds, and E then waited 1-1/2 seconds more before giving the child the signal to turn to the corresponding page in the answer booklet. After the sixth slide, E gave the additional instructions for the distraction condition:

> Good. This time you will hear a voice in the earphones. Don't pay any attention to it and go ahead just as you did before. Turn the page when I drop my arm.

The distracting story was again turned on through the earphones, picking up where it had been interrupted at the end of the simultaneous condition. The remaining six slides were shown during this condition. At the end of the tasks, the E removed the child's earphones and asked whether he had been listening to the story at all. E then asked a series of questions (See Appendix If) to test for memory for the story. The child's answers were recorded, and reassurance given if the child had difficulty remembering and seemed at all concerned about it. This was then followed immediately by the procedure for Delayed Auditory Feedback.

Numerical Distraction was given at the beginning of another individual testing session, ordinarily a week or two later, which also included the Blindfold Test, Mirror Drawing, and Delay of Gratification. The equipment used was the same as for Verbal Distraction. Numerical

Distraction involved two different tasks. For the Simultaneous condition the subject had to work a series of arithmetic problems alternating addition, subtraction, multiplication, and division (See Appendix If). The Successive condition involved recalling series of digits and identifying them among the alternatives in the answer booklet (See Appendix If). The digit series were of varied lengths from three to six. The instructions were as follows:

> Today we're interested in finding out a little more about how well you can work when there is something else going on. I'm going to put these earphones on you -- you won't hear anything in them for a while, but I want you to wear them a while and get used to them. (At this point the earphones are put on the child and he is given Form A. See Appendix If.) Here is a page of problems. When I say "start," I want you to begin here (top left) and work __down__ the column. When you finish with that column, start at the top of the next one, and so on. Work as quickly as you can until I say "stop." This time you won't hear anything in the earphones.

The child is given 3 minutes to work on Form A. He is then given Form B for the distraction condition, with these instructions:

> Good. Now I want you to work on this page in just the same way, only this time you will hear a voice in the ear- [illegible] quickly as you can.

The time allowed for Form B was also three minutes.

For the __Successive__ condition the digit series which the child was to remember and recognize were projected with the tachistoscope. The instructions were:

> Now this time I am going to show you some numbers on the screen for a short time; then the numbers will go off and you are to try to remember them. We will wait for a little while, then I will give you a signal with my hand and you are to turn to the first page of this booklet and find the number you saw and put a circle around it. This time you won't hear anything in the earphones.

The first slide is used as a demonstration. The slides were exposed for 2 seconds, then the child was allowed to turn the page of the booklet and select the correct alternative after 3 seconds. The first 10 slides constituted the baseline condition, slides 11 - 20 were used for the distraction condition. This was introduced with another announcement that the child would hear the voice through the earphones.

Scoring, distraction tests

The measure of susceptibility to distraction is, in each case, the score the subject achieved in the baseline condition minus the score he achieved under distraction. In the Verbal and Numerical Simultaneous tests, the score for each part (baseline and distraction) was the number of items correct minus errors. In the Successive tests the score was simply the number of items correct. A constant was usually added to the distraction scores (i.e., the difference scores) to eliminate negative numbers. The various distraction scores we used in our analysis are all combinations of these four basic scores: Verbal Simultaneous, Verbal Successive, Numerical Simultaneous, Numerical Successive. The variables are as follows:

1. Total Verbal Standard Score: Verbal simultaneous raw score plus verbal successive raw score. Total then standardized.
2. Total Number Standard Score: Number simultaneous raw score plus number successive raw score. Total then standardized.
3. Total Simultaneous: Sum of verbal simultaneous and number simultaneous standard scores, minus 50.
4. Total Successive: Sum of verbal successive and number successive standard scores, minus 50.
5. Grand Total: Sum of total verbal and total number standard scores, minus 50.

6. Total Verbal minus Total Number: Difference between the two standard scores, plus 50.
7. Total Simultaneous minus Total Successive: Difference between the two standard scores, plus 50.

In addition, we obtained a score for the number of items remembered from the distracting story and a score for the difference between that and the verbal distraction score. All of these variables were treated as one or two digit codes on our IBM storage decks. Since all of the scoring was a purely mechanical treatment of the subjects' answer forms, no assessment of reliability was made, although there was careful checking for possible clerical errors.

Gottschaldt Figures

We wished to employ a group-administered form of the test. Witkin had found in preliminary work that Gottschaldt's original black and white figures were not difficult enough to provide a good distribution of scores, and he found that he could increase the "embeddedness" of a hidden figure by a strategic use of color. We used Witkin's color form of the Gottschaldt figures (Witkin, 1950), omitting his forms number A-2 and E-2, which were two of his most difficult figures. In all, we used 22 figures, of which one was used for demonstration, so that the final test had 21 items. Witkin administered the test to subjects individually; we wished to convert the test to a group-administered form so that we could test simultaneously all the differential abilities children who were in the same school. We made up a booklet of Gottschaldt figures mounted on 3 x 5" cards. The simple figure appeared on one side of a card, and the complex figure appeared on the back of the same card, so that the child could not look at both simultaneously. Blank cards were placed between stimulus cards. The child was given the following instructions:

> "I'm going to show you a booklet with a page that has a small, simple figure on one side, and a large colored one on the other side. You'll find you can see the small simple one in the large colored one. Try to find the figure that is exactly the same size and shape and in the same position. When you find it, take the pencil I'll give you and draw around it."
>
> The experimenter then demonstrates with the first figure, helping the child to find the figure if necessary. After the sample is completed, the experimenter says:
>
> "The rest of the book has more pages like this, with blank pages in between. When I give the signal, go through the book as quickly as you can. Look at the small figure. Then turn the page and look at the large colored figure. You may turn the page back and forth as much as you wish. When you find the small figure in the large colored one, draw around it. Work as quickly as you can. We know some are quite hard to find. Try hard on every one. But if you find one you simply can't do after you've tried a long time, skip it and go on. We want to see how quickly you can find the small simple figures."
>
> After 15 minutes, E says: "Stop now. I'll let you come back to this in a little while. Leave the book open so you don't lose your place and turn it over so it's face down."

The child was given 15 minutes to work on the figures, and then worked on a different task. He then was allowed to return to the Gottschaldt figures for another 15 minutes. He turned in his booklet when he had completed as many as he felt he could, and the total time he required was recorded. We felt that our procedure for timing the test was not entirely satisfactory. Many of the children did not complete all the figures. They would work briefly on a difficult figure, decide that they could not do it, and go on to the next one. Having gone through the booklet in this way, some would then turn in their booklets saying they had finished as many as they could do; others would go back to the figures they had not been able to find, and spend additional time trying to solve them. Thus, our time measure was to some degree a function of task persistence as well as of the child's skill in solving the problems. For future users of this test in a group administration situation, we recommend a different method of timing. One possibility would be to give the group of subjects a time limit (perhaps 2 minutes) for each card, and have all the subjects move from one card to the next simultaneously.

A substantial majority of our subjects completed all the figures they felt they could do within the 30-minute time limit. Hence our group-administered form could be considered essentially a "power" test.

Scoring and reliability, Gottschaldt figures

Each one of the figures was scored on a three-point scale; 0 if the figure was omitted or if the child's drawing was completely wrong; 1 if the drawing was partly correct (e.g., correct in shape but wrong in size or orientation; or with two or three sides correct but the remainder incorrect), and two points for a fully correct reproduction. Two raters discussed the criteria for these judgments, and the reliability was .99 (correlation of the total scores which two independent raters assigned to a sample of 20 children). The split-half reliability of our 21-item group-administered form is .83 without correction for length (The Spearman-Brown correction brings it up to .907).

From the initial scoring, we derived three scores, as follows:

1. Total correct. As noted above, this is a point score in which the subject receives 2 points for a completely correct response, 1 point for a partially correct response, 0 for an incorrect response. These points are totaled over the 21 items in the test.

2. Proficiency score. This score takes into account both the correctness of the responses and the speed of solution. "Total

correct" scores were standardized. Total time spent on the test was also standardized. The proficiency score is a ratio: the standard score for total correct divided by the standardized time score. A constant of 50 was added to eliminate decimals and negative scores.

3. Percent correct. A ratio; total correct (as defined above) divided by number of items attempted. Standardized, and a constant of 50 added.

Perception of Ambiguous Stimuli[**]

Procedures and measures

The material consisted of six slides to be presented tachistoscopically at gradually increasing exposure times, and which the children were to guess at and copy as soon as they had some idea what the slide was. The method of "impoverishment of stimuli" was used, as described in detail in Mussen (1960) and Woodworth and Schlosberg (1954). Essentially, this method is designed to reduce the "power" of the stimulus, thus enhancing the role of the internal variable to be studied. The tachistoscopic presentation of material further gives a sort of theshold limit of the stimuli presented, and therefore, an estimate of relative goodness of perception. Specifically, the six slides consisted of two figures, two groups of letters, and two number series. In order to bring out the differences among subjects on early guessing and resistance to shifts in guessing behavior, the stimulus material was deliberately designed to resemble a simple, or "expected" pattern. Hopefully this would arouse more "expectancies" from the child's repertoire and therefore differentiate better among styles of responding. For example, one of the letter series was HOUSE. The stimuli were presented in this order: Verbal, Spatial, Numerical; Verbal, Spatial, Numerical.

The screen was placed six feet from the projector, with the children sitting from 4-8 feet from the screen. The room was always dimly-lit, never completely dark. As soon as the children entered the room, they were given booklets consisting of six pages with seven numbered mimeographed squares on each. The following instructions were read to them:

> "I'm going to show you some pictures on this screen. I'll show each picture six times. The first time I flash it on the screen, it will be for a very short length of time, and you'll just barely see it, or maybe not see it at all. The next time, it will be a little clearer, the next time even clearer, and so forth. As soon as you have some idea what it is, copy what you see in the square beside the right number. For example, if you have an idea what it is on the first showing, make your copy here, beside #1 (E illustrates). The second time, you would put down what you see here, beside #2, and so forth. After I've shown it six times, I'll leave it on the screen, so everyone can see it, and I want you to make another copy here at the bottom of the page. Finally, whenever you're _sure_ that your answer is right, put a plus sign next to the copy you have just made. Are there any questions?

Additional instructions to the examiner read, "If they want to know _how_ sure, _when_ to begin guessing, etc., just repeat, '...as soon as you have some idea what it is.'"

The slides were presented at intervals of 1/200, 1/100, 1/50, 1/10, 1/5, 1/2, except for two of the more difficult slides. For those, the intervals were 1/200, 1/50, 1/10, 1/5, 1/2, 1". The children were allowed ample time between each presentation to copy the figure. In all, each session took from 35-45 minutes making the time interval between presentations approximately one minute.

Scoring

1. _Correct perception_. These scores are determined by giving the

subject 7 points if he is correct on the first presentation, 6 on the second, 5 on the third, etc. High scores thus reflect high early accuracy of perception.

2. *Guessing*. Trial on which S first begins guessing.

3. *Shifts*. Number of shifts he makes to different responses, as the stimulus becomes clearer.

4. *Sureness*. Trial on which S first makes his final judgment of "sure." As in the case of "correct perception" scores, the child gets a score of 7 if he says he is "sure" on the first presentation, 6 on the second, etc., so that a high score means that the child says he is "sure" on early trials when the stimulus is still being presented only very briefly.

The scores for "correct perception" and "sureness" were first given separately for the three different kinds of stimulus material, and then summed for total scores.

CHAPTER V. RESULTS

In the following analysis, we have combined groups, in order to contrast children who are high in a given ability with those who are low in the same ability. Thus, the high-verbal low-math group has been combined with the high-verbal low-space group into a total high-verbal group and this group has been contrasted with a low-verbal group some of whom are high math and some of whom are high space. We have followed the same procedure in contrasting high-space with low-space children, and in the high and low-number groups. By the nature of our study design, the high-low comparisons for the three different ability areas are not independent of one another. That is, our group of high-verbal children is made up of individuals half of whom also appear in the low number group, the other half in the low-space group, since they were selected as being not only high in one ability area but low in another. If one compares the three high ability groups with one another, however, there is no overlap of cases, and this is also true if one compares the high group with the low group in any one ability area.

The designation "PMAC" after any measure indicates that the figures presented are "PMA constant"scores.

Dependency

Several of our initial hypotheses do not fare very well when we examine the differences between our differential abilities groups with respect to our measures of dependency. It will be recalled that we expected the high-verbal children to be more dependent. For those measures which do yield significant differences, the high-verbal children are less dependent than the low. As Table 5.1 shows, for the measures in which children's behavior was appraised by their classmates, high-verbal girls were seen as less likely to "show off" to get attention from their classmates than were the low-verbal girls. On the self-administered scales, highly verbal boys reported themselves as less likely to seek help from adults when in an anxiety-producing situation than low-verbal boys.

The results are not entirely consistent, however. High-verbal boys were reported on the PNI measures to be somewhat more dependent on the teacher than low-verbal boys, although the difference was not significant (<.10), and this difference is in the direction originally predicted. High-verbal boys, then, have relatively low dependency scores when they answer questions about how they would feel or behave in a variety of situations, but their answers do not correspond to the way other children see them. High-verbal girls are low in dependency on both kinds of measures, although not significantly so on the self-administered scales.

We expected that low-verbal children would have more dependency anxiety than high-verbal children. This is to some degree confirmed. Among girls, the low-verbal children are slightly more likely to express derogatory feelings about manifestations of dependency in other children ($p = <.06$), and for both sexes, the low-verbal children more often expect negative reactions to their dependency bids (significant for girls, not for boys). It appears, then, that while low-verbal children show some evidence of relatively great dependency anxiety, this does not prevent them from manifesting dependent behavior to a greater-than-average degree.

We had anticipated that the high-number children would be inclined to withdraw from interpersonal relationships. This proved to be entirely untrue. For both sexes, the high-number children were conspicuously sociable. They were rated significantly lower by their classmates on withdrawal tendencies than were low-number children; the high-number children of both sexes were higher on the self-administered measures of tendencies to seek help from adults under anxiety-producing conditions. Girls appear to have made certain discriminations concerning the conditions under which it is appropriate to show their dependency for while the high-number girls say they would ask for help when sick, alone, or afraid, they say they would not do so if encountering difficulty with a problem (at least, they would not do so as often as low-number girls). Perhaps this discrimination is related to the fact that high-number girls do not expect that their parents will interrupt what they are doing to respond to a dependency bid. In our "anticipation of punishment" scale, we depicted situations in which children interrupted their parents; activities to ask for help which was not really required (help to find a toy, company in playing a game). We suspect that the parents of high-number girls may have, more thoroughly than most parents, taught their daughters to discriminate between those situations in which they may reasonably ask for help and those in which they are expected to deal with a situation by themselves.

With respect to high-space children, we predicted that they would be relatively low in dependency, and relatively high in mastery. For boys, high-space children do not differ from low-space children in

Table 5.1. Mean scores and standard deviations on measures of dependency, mastery, and sociability, differential ability groups.

BOYS

	Verbal		Number		Space	
Peer Nom. Inventory	High	Low	High	Low	High	Low
Number of cases	(22)	(24)	(23)	(23)	(25)	(23)
Dep. on teacher (PNAC)	11.64	10.33	10.52	11.61	10.68	10.87
	(2.80)	(2.84)	(2.18)	(3.48)	(3.37)	(1.98)
Dep. on peers, attention-seek. (PNAC)	11.68	10.92	11.74	11.26	10.88	12.09
	(3.12)	(2.77)	(2.71)	(3.15)	(2.89)	(2.75)
Dep. on peers,' other (PNAC)	11.00	10.17	10.39	11.70	10.72	10.26
	(2.59)	(2.87)	(1.97)	(3.33)	(3.67)	(2.00)
Total dependency (PNAC)	11.73	10.50	11.13	11.61	10.76	10.50
	(3.29)	(2.99)	(2.74)	(3.57)	(3.31)	(2.73)
Withdrawal	7.00	7.13	4.96 *	8.00	7.64 *	4.52
	(5.93)	(6.27)	(4.48)	(5.43)	(5.68)	(3.96)
Likeability (PNAC)	9.86	9.21	10.74	10.65	9.96	10.74
	(3.48)	(2.92)	(2.61)	(3.88)	(3.68)	(2.85)
Mastery (PNAC)	10.55	9.25	11.39	10.17	9.68 *	12.17
	(3.10)	(2.98)	(3.34)	(3.18)	(3.25)	(3.07)
Self-admin. scales						
Dep. on adults, problem-solving	12.50	12.58	12.61	11.43	11.68	12.70
	(1.97)	(2.12)	(2.41)	(2.65)	(2.94)	(2.09)
Dep. on adults, sick, alone (PNAC)	9.18 *	10.83	11.30 *	9.65	10.16	10.17
	(2.57)	(2.58)	(2.05)	(3.07)	(2.96)	(2.28)
Total dep. on adults (PNAC)	9.54 *	11.17	11.83 **	9.35	9.88	10.70
	(2.92)	(2.78)	(2.46)	(3.40)	(3.12)	(2.53)
Restore positive relations (peers)	25.73	26.67	27.35	25.70	27.12	27.91
	(5.55)	(5.36)	(5.16)	(5.37)	(5.04)	(4.89)
Sociability	29.00	29.79	29.61	27.35	29.24	30.70
	(5.14)	(5.36)	(4.93)	(4.84)	(5.32)	(4.59)
Mastery	23.59	25.38	25.52	24.17	24.92	24.52
	(4.46)	(4.86)	(4.35)	(5.43)	(5.56)	(4.30)
Derogation of dep.	22.41	21.75	22.22	21.39	21.40	22.83
	(4.06)	44.36)	(3.83)	(5.00)	(5.51)	(4.81)
Anticipation of punishment for dep.	14.45	16.75	17.43	15.00	16.20	16.39
	(7.92)	(7.60)	(6.48)	(7.66)	(8.27)	(7.75)

Numbers in parentheses are standard deviations.

* Significant at .05 level. ** Significant at .01 level.

Table 5.1 (con'd). Mean scores and standard deviations on measures of dependency, mastery, sociability.

GIRLS

	Verbal		Number		Space	
Peer Nom. Inventory	High	Low	High	Low	High	Low
Number of cases	(18)	(20)	(17)	(13)	(21)	(23)
Dep. on teacher (PNAC)	10.78 (2.17)	11.35 (2.43)	12.00 (2.70;	12.00 (2.45)	11.19 (2.18)	10.87 (2.33)
Dep. on peers, attention-seek. (PNAC)	9.56 * (3.30)	11.80 (2.96)	11.65 (3.98)	11.15 (3.70)	11.67 (3.54)	10.17 (4.18)
Dep. on peers, other (PNAC)	9.22 (2.80)	10.60 (2.78)	10.71 (3.80)	10.77 (3.31)	11.00 (2.71)	9.87 (3.42)
Total dependency (PNAC)	9.83 (3.34)	11.90 2.91)	12.00 (3.83)	11.54 (3.90)	11.71 (3.47)	10.39 (3.95)
Withdrawal	9.61 (4.11)	7.00 (4.01)	6.18 ** (3.81)	11.95 (5.43)	9.19 (5.83)	7.70 (4.55)
Likeability (PNAC)	10.28 (2.86)	11.05 (2.93)	11.24 ** (2.78)	8.29 (1.82)	10.24 (2.71)	11.04 (2.84)
Mastery (PNAC)	9.89 (3.01)	11.35 (4.40)	10.71 (3.72)	9.15 (2.25)	11.38 (3.93)	10.57 (3.20)
Self-admin. scales						
Dep. on adults, problem-solving	11.83 (3.20)	12.80 3.23)	11.76 (2.84)	13.46 (1.69)	13.18 * (2.38)	11.26 (2.74)
Dep. on adults, sick, alone (PNAC)	10.17 (2.06)	10.85 (1.52)	10.24 * (1.63)	8.62 (2.27)	9.67 (2.30)	10.04 (1.90)
Total dep. on adults (PNAC)	9.89 (2.86)	11.00 (1.92)	10.18 (2.01)	9.23 (3.07)	10.05 (2.75)	9.57 (2.50)
Restore positive relations (peers)	27.00 (5.80)	28.50 (4.90)	30.52 (2.27)	27.85 (3.16)	27.19 (4.81)	28.04 (5.71)
Sociability	29.50 (4.96)	29.55 (3.04)	31.71 (4.34)	30.43 (6.05)	28.95 (4.86)	30.43 (5.38)
Mastery	26.17 (4.67)	25.55 (4.48)	24.41 (4.94)	25.15 (3.48)	24.90 (3.20)	26.30 (4.55)
Derogation of dep.	17.94 * (3.82)	20.30 (3.61)	19.65 (4.13)	19.00 (4.30)	20.29 (2.58)	18.70 (3.08)
Anticipation of punishment for dep.	15.00 * (8.43)	17.55 (7.43)	19.18 * (5.69)	13.85 (6.06)	15.28 (6.98)	16.78 (7 66)

Numbers in parentheses are standard deviations.

dependency, asmmeasured by either the PNI or the self-administered scales. They do show a tendency to withdraw from interpersonal interaction, which might be regarded as a manifestation of independence. But contrary to our prediction, they are low in mastery (PNI measure).

When we find differences among our groups in their dependency or sociability with peers, we may ask which of our groups is "out of line" in comparison with the total population from which our sample of children is drawn. For example, it would be interesting to know, when we find that our low-number boys are more withdrawn than the high-number boys, whether the high-number boys are unusually sociable or the low-number boys unusually withdrawn, in relation to the usual behavior of boys in these classrooms. We can answer this question with respect to some of our measures. In the process of collecting PNI ratings on the children selected for our special "differential abilities" sample, we also obtained scores for the rest of the children in the same classrooms. As may be seen in Table 5.2, our six differential ability groups, taken together, were not notably deviant with respect to those traits measured in the PNI. And we see that our high-number boys are especially well-liked, especially low on withdrawal tendencies, by comparison with their total group of classmates -- the low-number boys are about average in these respects, and it is the unusually high sociability of the high-number boys that accounts for the difference between them and their low-number counterparts.

Returning to our initial expectations concerning the relationship between interpersonal relationships and cognitive abilities: we expected that verbal ability, more than the other abilities, ought to

Table 5.2. Mean scores: Peer Nominations scores related to dependency and sociability. Differential abilities groups compared to normative sample of classmates.

PNI scale:	Normative sample	Total:Diff. Abil.groups	Verbal High	Verbal Low	Number High	Number Low	Space High	Space Low
BOYS								
Total dependency	24.5 (12.4)	22.4 (13.2)	23.7 (14.0)	19.6 (12.1)	22.3 (11.2)	25.0 (14.3)	21.3 (13.9)	22.7 (12.4)
Dependency on teacher	3.7 (3.0)	3.6 (3.1)	4.1 (3.1)	3.1 (2.9)	3.2 (2.7)	4.5 (3.6)	3.6 (3.4)	3.3 (2.5)
Dependency on peers: attention-seeking	14.3 (9.7)	12.1 (9.9)	12.6 (10.8)	10.3 (9.5)	12.7 (8.8)	12.8 (10.3)	11.0 (10.1)	13.1 (2.5)
Dependency on peers: other	6.5 (2.6)	6.7 (2.9)	7.0 (2.6)	6.2 (2.9)	6.4 (2.0)	7.7 (3.3)	6.7 (3.7)	6.3 (2.0)
Withdrawal	6.9 (5.3)	6.6 (5.5)	7.0 (5.9)	7.1 (6.3)	5.0 (4.5)	8.0 (5.4)	7.6 (5.7)	4.5 (4.0)
Likeability	16.6 (8.0)	19.1 (7.8)	19.5 (7.0)	17.1 (7.8)	20.4 (6.8)	18.8 (8.6)	17.6 (8.9)	21.6 (5.9)
Mastery	13.8 (7.8)	15.0 (7.3)	15.6 (6.6)	12.6 (7.1)	17.0 (6.8)	13.5 (7.2)	12.6 (7.7)	19.0 (5.8)
GIRLS								
Total dependency	22.6 (11.0)	22.5 (11.7)	16.9 (10.4)	25.2 (10.1)	24.7 (12.8)	24.2 (10.6)	25.4 (10.0)	19.0 (12.7)
Dependency on teacher	4.3 (3.3)	3.9 (2.8)	2.8 (2.2)	4.3 (2.7)	4.5 (3.2)	4.9 (2.6)	4.3 (2.6)	3.0 (2.6)
Dependency on peers: attention-seeking	11.3 (8.0)	11.4 (7.4)	8.5 (6.6)	13.2 (5.8)	12.7 (8.0)	11.4 (7.3)	12.7 (6.9)	9.8 (8.4)
Dependency on peers: other	7.0 (3.4)	7.2 (3.4)	5.6 (2.8)	7.8 (3.3)	7.4 (4.0)	7.9 (3.2)	8.4 (2.7)	6.3 (3.3)
Withdrawal	7.1 (5.5)	8.4 (5.0)	9.6 (4.1)	7.0 (4.0)	6.2 (3.8)	11.9 (5.4)	9.2 (5.8)	7.7 (4.6)
Likeability	18.0 (9.4)	19.0 (8.6)	18.3 (8.7)	20.3 (8.7)	20.9 (8.4)	13.8 (6.2)	18.0 (8.5)	20.8 (8.6)
Mastery	13.8 (8.0)	14.4 (7.8)	13.8 (6.2)	15.8 (9.0)	14.5 (7.8)	10.5 (5.7)	14.8 (9.0)	15.4 (7.0)

The figures appearing in this table are means of raw scores obtained on the PNI. They differ from the figures presented in Table 5.1, for there, in most instances, the PMA constant scores were employed.

reflect a history of close interpersonal ties with parents. In Dr. Bing's report of observed interaction between our sample children and their mothers (See Appendix III), we have evidence that this is true. We further expected that close dependency ties with parents would generalize to the child's relationship to peers in school. Our evidence suggests that this is not the case. We can now advance the contrary hypothesis, that if a child at age 11 is still closely tied to his parents (and perhaps other adults including the teacher), he will have a less close relationship with his peers. Dependency upon adults may be seen, then, not as a trait which generalizes to interaction with age-mates, but as a behavior tendency which interferes with social adjustment to peers. This position is consistent with the findings of Marshall and McCandless (1957), who find significant negative correlations between pre-school children's dependency on adults and their level of social interaction with, and acceptance by, their peers. Among the girls in our study, we see that the highly verbal children show evidence of a continued dependent relationship to their parents in that they do not derogate dependency upon adults and they do not expect negative reactions to their dependency bids, even when these are "unjustified." These same girls are slightly withdrawn (not significantly so) in the school situation, and low in dependency toward peers. Among boys, there is little consistent relationship between our measures of dependency and the boy's verbal ability. With respect to number ability, the high-number boys appear to have been detached by their parents from over-close dependency upon them, for these boys do not expect help from their parents when they ask for it needlessly;

and these same boys are quite clearly more sociable with their peers. However, the high-number boys report more dependency impulses toward adults on the self-administered scales. We will discuss the hypothesis further when we summarize and discuss the results from the entire study.

Aggression

We had expected that high-number children would be characterized by a tendency to inhibit the expression of impulses, and we predicted specifically that the high-number children would obtain higher-than-average scores on measures of aggression anxiety, while scoring low on measures of overt aggression. Among the boys in our sample, we find quite a different picture than the one we anticipated. High-number boys are more aggressive than low-number boys, on the Peer Nominations measure of this trait (See Table 5.3). We must hasten to add that this does not mean that our high-number boys were more aggressive than the total group of their male classmates. As previously noted, we also obtained PNI measures on the rest of the children in our subjects' classrooms. When we compare the scores of our selected groups with those of the normative group of their classmates, we find that the high-number boys had very similar scores on aggression to those of the other boys in their classes. It was the low-number boys who were different from the normative group: These boys were significantly less aggressive than their classmates (See Table 5.4). These low aggression scores characterzzed both our high-verbal and our high-space boys. This latter point is interesting in view of the fact that we expected that children adept in spatial tasks would be free in impulse

Table 5.3. Mean scores and standard deviations on aggression. Differential abilities groups.

	Verbal		Number		Space	
	High	Low	High	Low	High	Low
BOYS						
Peer Nominations Inventory						
Total aggression (PMAC)	10.41	11.12	12.78 *	10.22	10.20	12.00
	(2.93)	(4.18)	(4.81)	(2.30)	(2.12)	(3.91)
Good fighter, sub-score	3.09	4.00	6.00 **	2.78	3.24 *	5.52
	(3.53)	(3.83)	(4.68)	(2.60)	(2.47)	(4.47)
Self-administered scales						
Aggression anxiety (PMAC)	10.09	10.54	9.91	10.52	10.32	9.26
	(2.33)	(2.61)	(2.45)	(2.52)	(2.75)	(2.23)
Anti-social aggression	17.04 *	14.21	16.52	18.09	15.88	17.17
	(4.28)	(3.46)	(3.56)	(4.27)	(4.22)	(3.32)
Projected aggression (PMAC)	10.91	10.17	9.78	10.35	9.68	9.78
	(2.50)	(2.23)	(2.14)	(2.90)	(2.51)	(2.24)
GIRLS						
Peer Nominations Inventory						
Total aggression	10.33	11.85	10.82	12.00	12.52	10.43
	(3.60)	(2.90)	(3.18)	(3.78)	(3.71)	(3.98)
Good fighter, sub-score	3.00	4.45	2.35	2.77	4.52	2.78
	(3.28)	(4.12)	(2.08)	(2.69)	(4.34)	(3.24)
Self-administered scales						
Aggression anxiety (PMAC)	11.89 *	9.30	10.88	10.62	9.00 *	11.48
	(2.58)	(3.16)	(3.77)	(2.50)	(2.72)	(3.42)
Anti-social aggression	13.22	13.95	12.41	13.46	14.71	13.22
	(3.94)	(3.79)	(2.70)	(3.50)	(3.21)	(3.09)
Projected aggression (PMAC)	7.98	11.00	10.65	9.85	11.05	10.48
	(3.44)	(2.47)	(2.35)	(3.03)	(2.28)	(2.80)

Figures in parentheses are standard deviations. * Significant at .05 level.
** Significant at .01 level.

Table 5.4. Peer-rated aggression; normative and differential abilities groups compared.

	Normative Sample	Total:Diff. abil.sample	Verbal		Number		Space	
			High	Low	High	Low	High	Low
			BOYS					
Total aggression	42.15 (29.58)	31.13 (22.81)	25.54 (19.10)	30.21 (25.45)	41.09 (29.31)	28.17 (15.39)	26.88 (14.47)	35.04 (25.11)
Good fighter	5.04 (4.07	4.10 (3.88)	3.09 (3.53)	4.00 (3.83)	6.00 (4.68)	2.78 (2.60)	3.24 (2.47)	5.52 (4.47)
			GIRLS					
Total aggression	31.36* (25.84)	30.39 (25.36)	24.06 (25.67)	33.60 (20.29)	27.00 (21.87)	35.15 (25.83)	38.57 (25.54)	24.91 (27.91)
Good fighter	3.69 (3.12)	3.38 (3.56)	3.00 (3.28)	4.45 (4.12)	2.35 (2.08)	2.77 (2.69)	4.52 (4.34)	2.78 (3.24)

Figures in parentheses are standard deviations.
* These scores are not corrected for the correlation with total PMA.

expression and hence would score high on aggression. Among boys, the opposite is the case.

Among the girls in our sample, there were no significant differences between groups in the amount of aggression displayed, either on the self-report measures or the Peer Nominations scores. There are tendencies, however, for high-number girls to be less aggressive than their low-number counterparts, while it is the high-space girls who tend to be most aggressive. The findings on girls, then while not significant, are in the direction of our predictions. The measure which best distinguishes among our groups of girls is the scale on aggression anxiety, where we find that high-verbal girls and the low-space girls obtain the highest scores. High-verbal boys are significantly higher than low-verbal boys in self-reported anti-social aggression, although the difference on peer-rated aggression is in the other direction.

Generalization of the results to an unselected sample

We have reported certain findings concerning the relationship of verbal, numerical, or space ability to dependency, aggression and sociability. The question arises whether these results can be generalized to any degree to a cross-section sample of children of this age, or whether they are valid only for children chosen as ours were -- children who are not only especially skillful at one kind of task, but especially poor at another kind of task.

For most parts of our study, we cannot answer this questions, for we administered most of our measures only to our selected children. But, as previously mentioned, we do have scores on the Peer Nominations measures for the classmates of our sample children. We also administered the Primary Mental Abilities test to these same classmates, at the initial phase of the study, before we had selected our differential ability groups. We also obtained the scores on standard school-administered tests for all the children in the class and combined these scores with PMA sub-test scores to obtain summary measures of verbal, number, and space ability. It is, therefore, possible to correlate these separate ability scores with the PNI personality scores for our sample's classmates, to see whether we find similar relationships to those revealed in our comparison of differential ability groups. There is a problem in doing so, however, for, of course, the ability sub-scores are highly correlated with total "intelligence" (as measured by total PMA scores), and in our comparison of differential ability groups we have held constant the effects of total intelligence. We have, therefore, employed partial correlations, correlating PNI scores with the verbal, number, and space scores, with total PMA partialed out. The results may be seen in Table 5.5.

In almost all instances, the direction of relationships obtained in this analysis sustains the findings reported previously in the comparison of differential ability groups, although the correlations are not always large enough to be statistically significant. We se, for example, that for both sexes likeability (popularity) is more highly correlated with number ability than it is with verbal, and that withdrawal is negatively correlated with number ability but not with verbal or spatial ability. And we again find that spatial ability is

Table 5.5. Correlations between Peer Nominations Scores and Verbal, Number, and Space scores: sample of classmates of the differential abilities groups.

PNI Scale	Tot. PMA	Tot.Verbal Sc.		Tot.Number Sc.		Tot. Space Sc.	
		Raw r	Partial*	Raw r	Partial*	Raw r	Partial*
				BOYS			
Total aggression	-.15	-.17	-.08	-.07	.11	-.02	.07
"Good Fighter"	-.06	-.05	.01	.04	.17	-.02	.01
Total dependency	-.29	-.26	-.03	-.29	-.09	-.20	-.06
Dep. on teacher	-.36	-.37	-.13	-.39	-.16	-.23	-.06
Attention-seeking	-.23	-.17	.03	-.20	-.02	-.13	.02
Dep. on peers	-.08	-.11	-.09	-.15	-.16	-.13	-.11
Withdrawal	-.33	-.26	.04	-.37	-.18	-.16	.00
Likeability	.42	.41	.12	.46	.22	.07	-.18
Mastery	.40	.40	.13	.44	.22	.10	-.13
				GIRLS			
Total aggression	-.10	-.15	-.12	-.11	-.05	-.09	-.10
"Good Fighter"	.00	-.03	-.05	-.02	-.02	-.10	-.11
Total dependency	-.17	-.14	-.01	-.13	.01	-.12	-.03
Dep. on teacher	-.24	-.18	.01	-.21	-.04	-.10	.04
Attention-seeking	-.06	-.10	-.09	-.08	-.05	-.06	-.03
Dep. on peers	-.22	-.07	.15	-.04	.20	-.18	-.07
Withdrawal	-.37	-.23	.01	-.29	-.09	-.14	.03
Likeability	.22	.22	.08	.28	.18	-.07	-.22
Mastery	.26	.24	.08	.30	.18	.02	-.19

* The correlations in this table represent the correlations between PNI scores and total verbal, number or space scores. The "total" ability scores are summary scores combining the relevant PMA sub-test with other test scores available in school records (See page 47). For the partial correlations, total PMA scores have been held constant.

negatively related to mastery: in our differential abilities groups, this was true only among boys, but in the analysis of their classmates, it is true for both sexes. And finally, although the correlations are small, we find that aggressiveness in boys is positively related to number ability, negatively related to verbal ability.

This analysis, then, gives us confidence that our results are not simply an artifact of our having chosen deviant groups of children, but have some validity across the normal range.

Selective attention to interpersonal cues

Table 5.6 presents the average scores of our high-low groups on our measures of sensitivity to interpersonal cues. We find that our highly verbal children are no more likely to recall the interpersonal content of a movie than the other children we studied; nor did our highly verbal children prove themselves more likely to infer motivational states in the stick figures test. Among boys, the low-number high-verbal children were the ones most likely to respond to the stick figures in a conventional fashion. That is, they got a high communality score, through giving a high number of "usual" responses. This finding, however, could be accounted for in terms of their greater accuracy in the use of words (one of the skills which caused them to be selected as high-verbal initially). Although this is consonant with Sarbin's findings of higher communality scores in more "empathetic subjects," it need not imply anything concerning their characteristic method of making use of interpersonal cues. Our tests are, then, essentially negative for our hypotheses. In the case of the Toby Tyler test, this may be partly due to the low split-half

Table 5.6. Means and standard deviations: measures of selective attention to interpersonal cues, differential abilities sample.

BOYS

	Verbal		Number		Space	
	High	Low	High	Low	High	Low
Toby Tyler difference score, mean (interpersonal minus non-interpersonal)	13.3 (6.10)	13.6 (5.25)	14.7 (5.05)	12.4 (4.71)	12.5 (4.72)	14.5 (5.89)
Stick figure :						
Communality	33.4 (13.0)	27.0 (15.2)	28.2 * (14.3)	37.3 (10.6)	32.6 (14.4)	30.1 (14.1)
Inferential	9.6 (2.19)	10.1 (1.88)	9.9 (2.08)	9.1 (1.85)	9.6 (1.55)	9.8 (2.00)
Descriptive	13.9 (1.36)	13.8 (1.67)	14.0 (1.37)	14.2 (1.53)	14.1 (1.65)	13.8 (1.13)
Difference (inferential minus descriptive plus 10)	5.4 (3.09)	6.3 (3.11)	6.0 (3.03)	5.4 (3.78)	6.0 (3.39)	5.7 (2.42)

GIRLS

	Verbal		Number		Space	
	High	Low	High	Low	High	Low
Toby Tyler difference score, mean (interpersonal minus non-interpersonal)	14.3 (4.14)	13.8 (4.34)	14.4 (6.27)	14.3 (5.21)	13.4 (4.42)	14.0 (5.38)
Stick figures:						
Communality	32.7 (13.5)	32.8 (13.5)	31.8 (12.3)	31.4 (10.4)	31.8 (13.0)	31.9 (13.7)
Inferential	10.2 (2.06)	10.7 (2.15)	9.9 (1.59)	9.7 (1.38)	10.3 (2.18)	10.1 (2.03)
Descriptive	12.9 (2.04)	13.1 (1.94)	13.3 (1.71)	13.9 (1.94)	13.6 (2.08)	13.2 (1.97)
Difference (inferential minus descriptive plus 10)	7.2 (3.88)	7.4 (3.77)	6.4 (2.68)	6.5 (3.59)	7.1 (4.24)	6.8 (3.73)

* indicates a difference significant at the .05 level.

reliability of our measures. But this is not the whole story, for the Toby Tyler difference score does correlate with verbal creativity, as will be shown later in the section on creativity. The Toby Tyler measure of sensitivity to interpersonal cues is also related to certain aspects of parent-child interaction. Therefore, the fact that this measure does not distinguish our differential ability groups from one another is more genuinely negative evidence for our original hypothesis than it would be if the measure were too unreliable to correlate with any of our measures.

Delay of gratification

We had predicted that our high-number children would be the least impulsive among our subjects, and hence be able to wait for a larger piece of candy "day after tomorrow." Among boys, the delayed choice is unrelated to the child's area of greatest ability. Among girls, the findings are opposite to our predictions, although not quite significantly so. The group most likely to make a delayed choice was the low-number girls, and their choice differed from that of the high-number girls at the .08 level of confidence.

Utilization of Kinaesthetic Cues

Blindfold test

The only significant difference between our groups is that high-number girls are superior in performance to low-number girls (See Table 5.8). This may reflect their greater ability to estimate distances and concentrate on the directions of the task. Our prediction that high-space children would excel at this task was clearly not sustained. This measure is unrelated to spatial ability. Possibly our

Table 5.7. Number choosing small immediate reward versus larger delayed reward: candy test. Differential abilities groups.

BOYS

	Verbal		Number		Space	
	High	Low	High	Low	High	Low
Candy choice, no. of cases:						
Immediate	7	6	4	5	7	7
Delayed	15	18	19	18	18	16

GIRLS

	Verbal		Number		Space	
	High	Low	High	Low	High	Low
Candy choice,						
Immediate	6	12	9	2*	9	10
Delayed	12	8	8	11	12	13

* The difference between the high-number and low-number girls in proportion choosing delayed reward reaches the .08 probability level, Fisher's exact test, two-tailed. None of the differences among the boys' groups approach significance.

assumption that performance in this situation would reflect the ability to utilize kinaesthetic cues was not correct. Or, alternatively, high-space children are not superior in their ability to utilize such cues.

Mirror drawing

In general, performance on this task is related to higher spatial ability, as we predicted. High-space children are superior to low-space children on the overall measure (See Table 5.8). The comparison is significant for girls and not significant but in the same direction for boys. The proficiency of the high-space girls is primarily due to a low number of errors, although the high-space girls are also faster and more accurate than their low-space counterparts. The rate, accuracy, and time sub-scores are not reported in the table. Our hypothesis that high-space children would perform better on this task, when visual cues were disrupted and they had to rely on kinaesthetic feedback, was substantially confirmed. This finding lends plausibility to our assumption that the development of spatial ability depends in part on learning to use the sensory feedback from one's own movements. There is, however an alternative interpretation, namely that both the mirror drawing task and the PMA space test involve imagining how a geometric figure would look if turned around. Perhaps both of these interpretations are correct, in that imagining how a figure would look if turned around involves covertly going through the motions of rotating it.

Delayed auditory feedback

Among girls, performance on the delayed auditory feedback test is not related to the child's area of greatest ability. Among boys, our

Table 5.8. Means and standard deviations: blindfold test, mirror drawing, and delayed auditory feedback. Differential abilities groups.

BOYS

	Verbal		Number		Space	
	High	Low	High	Low	High	Low
Blindfold test, total error(angle plus distance)	28.8 (1.64)	28.9 (2.08)	28.9 (2.78)	28.9 (2.15)	29.2 (2.14)	29.2 (2.48)
Mirror drawing total error	206.9 (19.5)	207.8 (26.6)	201.2 (25.4)	210.0 (23.2)	214.5 (26.8)	205.5 (24.4)
Delayed auditory feedback, total disruption score	33.4 (19.1)	29.5 (17.9)	27.2 (18.2)	36.5 (21.1)	30.0 (16.0)	24.5 (11.0)

GIRLS

	Verbal		Number		Space	
	High	Low	High	Low	High	Low
Blindfold test, total error	32.4 (4.08)	30.4 (4.13)	29.4 * (4.07)	33.5 (6.02)	32.0 (5.20)	30.9 (3.88)
Mirror drawing, total error	174.1 ** (31.9)	204.8 (23.2)	178.7 (39.7)	186.0 (46.3)	200.3 * (41.6)	168.0 (39.6)
Delayed auditory feedback, total disruption score	27.0 (11.0)	29.5 (13.2)	30.2 (17.1)	30.5 (13.5)	28.7 (12.9)	26.8 (14.4)

Figures in parentheses are standard deviations.
* Significant at .05 level. ** Significant at .01 level.

findings are somewhat surprising. The boys whose speech was most disrupted by the procedure were the low-number boys (See Table 5.8); the ones least disrupted were the low-space boys. These two groups were significantly different from each other.* The findings suggest that if one wished to predict a child's performance on the DAF test, one could do so more successfully by knowing what area of ability he is poor in than by knowing what he is good in. The results here are generally consistent with our findings on distractability (although there the differences were greater for girls than for boys), in that the low number children were quite distractable as well as disrupted by delayed feedback. But on the distractability tests, it was the high verbal children who did least well, and spatial ability made little difference. In delayed auditory feedback, spatial ability does make a difference, although it is not an asset, as we expected it to be. Rather, it is the children with the lowest space ability who speak most easily under delayed feedback. Thus, we have an additional piece of evidence against the view that high-space children are characterized by more skillful utilization of kinaesthetic cues.

Our findings are consistent with those of Witkin (1962), who reported that his scores on measures of field independence -- measures which overlap with our measures of spatial ability -- were not very closely related to sensitivity to body cues. One of Witkin's tests for field independence is the Body Adjustment Test, in which the individual must adjust his body position to the upright while surrounded by a tilted visual field. In order to do so the subject must, of course, make use of body cues and disregard the misleading visual ones. But his ability to do this proved to have little relation to tests of body steadiness and body balance, and also little relation to his ability to adjust his body to an upright position when his eyes were closed. Hence, Witkin rejected the hypothesis that field independence reflected a greater ability to use body cues, and we must do likewise with respect to spatial ability as we have measured it.

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* An F-test of differences among the 3 low-ability groups does not reach the .05 level of significance, however, so this significant t must be regarded as suggestive only.

Susceptibility to distraction

The main findings as to differences among our differential abilities groups in susceptibility to distraction are presented in Table 5.9. The general conclusion to be drawn from these data, with a considerable degree of confidence, is that high-verbal children are more distractible than low-verbal children and, on the other hand, high-number children are less distractible than low-number children. On the "grand total" distraction measure, these differences are significant at the .05 level for the verbal comparison and the .05 level for the number comparison for girls, and in the same direction but not significant for boys. If we compare high-verbal with high-number children, the differences are significant at the .05 level for girls. For boys, the probability of the difference is at the .10 level, approaching significance. The probabilities are two-tailed. These findings are certainly in line with our expectations about high-number children: that they would show more ability to focus attention on a task and would be less subject to interference from distracting stimuli. High-number boys are most clearly superior to low-number boys on the numerical tasks. They are

Table 5.9. **Means and standard deviations: measures of distractability. Differential abilities groups.**

BOYS

	Verbal		Number		Space	
	High	Low	High	Low	High	Low
Difference scores: base-line minus distraction condition						
Total verbal	52.4 (9.74)	50.5 (10.75)	49.3 (8.14)	50.4 (11.70)	48.9 (12.03)	49.4 (7.95)
Total numerical	52.0 (5.56)	49.1 (8.23)	48.1 * (9.69)	53.4 (6.50)	53.0 (7.62)	50.7 (8.82)
Total simultaneous	52.5 (8.48)	49.4 (16.31)	47.3 (12.32)	50.7 (10.15)	49.7 (16.06)	49.2 (11.62)
Total successive	52.3 (14.52)	48.6 (14.76)	46.4 (11.14)	54.9 (17.88)	54.4 (17.77)	50.0 (11.62)
Grand total	53.8 (10.11)	49.6 (15.16)	47.4 (11.22)	53.3 (13.69)	51.8 (16.69)	50.1 (10.11)
Story memory	7.6 (2.2)	6.5 (2.6)	6.1 * (2.5)	7.7 (2.6)	7.0 (2.9)	6.6 (2.5)
Difference score (verbal minus number)	51.3 (13.3)	49.7 (12.4)	47.4 (12.0)	54.0 (11.9)	53.4 (11.8)	48.7 (11.8)

GIRLS

	Verbal		Number		Space	
	High	Low	High	Low	High	Low
Total verbal	55.0** (10.35)	46.0 (9.52)	46.3 (11.57)	53.6 (10.00)	48.6 (9.63)	51.4 (11.84)
Total numerical	50.4 (9.31)	48.9 (9.89)	48.6 (8.86)	54.3 (9.54)	50.1 (9.02)	47.9 (7.02)
Total simultaneous	50.2 (15.09)	49.3 (13.46)	54.9 (17.01)	59.7 (13.27)	49.7 (11.94)	48.7 (15.09)
Total successive	56.4 ** (12.24)	45.4 (11.05)	44.7 (14.35)	48.5 (12.94)	46.3 (11.22)	52.6 (14.90)
Grand total	55.4 * (11.82)	44.2 (13.40)	44.9 * (12.67)	57.1 (13.07)	48.0 (10.68)	49.7 (8.20)
Story memory	6.4 (2.9)	6.4 (2.1)	5.9 (2.3)	5.5 (2.6)	6.1 (2.3)	6.4 (2.7)
Difference score (verbal minus number)	44.3 * (13.6)	55.2 (12.0)	51.1 (12.9)	42.3 (15.4)	50.1 (14.1)	46.3 (12.0)

*** Significant at the .05 level. ** Significant at the .01 level.**

also superior to high-space boys, who seem to be the lowest group on these tasks. These differences suggest that children may be less likely to be disupted by distraction on tasks at which they are in general more competent. While working on numerical tasks, however, they were being subjected to distraction by material which should have especially high interference value for high-number children, namely, arithmetic problems.

The differences among the boys' groups on the verbal tasks, although in the direction of high-berbal boys being the most distractable, are negligible, and it is largely the numerical tasks which contribute to the boys' differences on the total measure. This raises the question whether high-number children are generally able to focus attention and perform better in the face of distracting stimuli, or whether they do so only when the task is one at which they are relatively more skilled. The results are not conclusive for boys, although the difference between high and low-number groups is in the same direction on the verbal as on the numerical measures. For girls, however, it is clearly the case that the high-number group is less distractable and the high-verbal more distractable than the other groups, regardless of whether the measure on which they are being compared is a verbal or numerical one.

We have noted that high-verbal girls are more distractable than low-verbal girls, and this is especially true when the girls are working on verbal material and being distracted by verbal material. In fact, the distraction effects are negligible when these girls are working on numerical material during numerical distraction. It is evident, therefore, that we cannot make the generalization that children usually concentrate best on material with which they have the greatest competence. At least, they do not concentrate best on such material when they are being distracted by similar material.

The consistency of our findings concerning the ability of high-number children to shut out distraction is all the more impressive when we consider the interrelationships among the distraction measures. These are shown in Table 5.10. There is very little correspondence in the children's susceptibility to distraction from one task to another. As noted above, our procedure combines verbal tasks with verbal distractors, so we cannot tell whether a child's performance on the task is a function of the task or the distractor or both acting jointly. In the Verbal Distraction measures we have a check as to whether the amount of disruption a child showed was in general related to dividing attention between the task and the distracting stimulus. The score on the story memory test shows some slight positive relationship to verbal distraction scores in the successive condition, suggesting that the interference was in part due to the child's attending to the story. But, curiously, story memory also correlates slightly with numerical successive distraction, and, of course, the story was not being played while the children worked on numerical tasks. These facts suggest that there may be some general relationship between the tendency to divide attention (resulting in more incidental learning) and susceptibility to interference in performance on tasks which require keeping something in mind for a brief period.

Table 5.10. Intercorrelations among distraction measures. Differential abilities groups.

		Numerical	Simultaneous	Successive
Total verbal distraction	B	.02	.59	.53
	G	-.25	.35	.51
Total numerical distraction	B		.64	.31
	G		.33	-.03
Total simultaneous distraction	B			.20
	G			-.11

		Verbal successive	Numerical simultaneous	Numerical successive	Story memory
Verbal simultaneous	B	.20	-.08		.11
	G	.19	-.15		.04
Verbal successive	B		.10	-.05	.31
	G		-.21	.03	.12
Numerical simultaneous	B			-.07	-.03
	G			-.08	.00
Numerical successive	B				.16
	G				.40

We do not know, of course, whether it is this factor (the tendency to divide attention) which accounts for the differences among our groups in susceptibility to distraction. Among girls, it would appear not to be the explanation, for while the high-verbal girls are significantly more distractable than the low-verbal girls, they do not remember any more of the content of the distracting story. Still, it seems at least plausible that the learning of verbal skills might be facilitated by a tendency to spread attention broadly over the immediate situation and to pick up many incidental cues, particularly when they have interpersonal import, as our distracting story did. Such a tendency may, on the other hand, be detrimental to the learning of numerical material. Perhaps learning to perform well at arithmetic problems requires, more than do other tasks, the ability to focus attention on the given task to the exclusion of other aspects of the environment. And this may be particularly important because mathematical operations involve keeping in mind elements of the solution to the problem which are not immediately present. At any rate, we have clear evidence that susceptibility to interference from distracting stimuli is positively related to differential verbal ability, negatively to differential number ability, and appears to be unrelated to spatial ability. While these relationships may be detected in both sexes, they are most consistent and clear for girls.

Gottschaldt figures

The raw scores of the sample children on Gottschaldt figures were correlated positively with total scores on the Primary Mental Abilities test (.36 for boys, .44 for girls). We, therefore, employed

"PMA constant" scores in the group comparisons which are reported in Table 5.11. It may be seen that the high-space children were the ones who were most proficient on Gottschaldt figures. The differences were greater for boys than girls. The superiority of high-space children on the Gottschaldt figures test is not surprising in view of the fact that the space tests which were employed to select these children appear to have elements in common with Gottschaldt figures, in terms of the kind of abilities required to solve them. The PMA space test, for example, involves imagining how a figure would look if it were rotated through part of an arc, and then matching this rotated figure with one of a new set of drawings. To do this the subject must momentarily free himself from the immediately-present stimulus and perform internal analytic operations upon it. To some degree, the same ability is required in the Gottschaldt figures, where the subject must suppress *the binding qualities of the complex figure taken as a whole and* select one element to match with the memory image of the simple figure. As previously noted, Thurstone has employed an adaptation of the Gottschaldt, and has found that it has a heavy loading on the same perceptual factor as measures of spatial ability. Hence, the simplest way to state our results is that the Gottschaldt figures test served to validate the original selection of the high-space children in this study. Gottschaldt figures probably involve other kinds of abilities in addition to the ones called for in our original space tests, but they also involve the same abilities to a sufficient degree to produce a superiority on the Gottschaldt test among our high-space children.

Table 5.11. Means and standard deviations: Gottschaldt figures. Differential abilities groups.

BOYS

	Verbal		Number		Space	
	High	Low	High	Low	High	Low
Gottschaldt scores: scores:						
Total correct	10.2	11.8	9.3	11.6	12.1 **	8.4
PMAC	(3.18)	(2.74)	(3.13)	(2.57)	(2.75)	(3.25)
Proficiency	10.1 *	12.5	10.6	11.2	12.5 **	9.3
PMAC	(2.97)	(2.92)	(3.19)	(3.02)	(3.02)	(2.72)
% Correct	10.8 *	12.5	9.7 *	11.9	12.9 **	9.1
PMAC	(2.64)	(2.33)	(3.27)	(2.32)	(2.27)	(3.27)

GIRLS

	Verbal		Number		Space	
	High	Low	High	Low	High	Low
Total correct	10.9	11.7	10.7	11.6	11.8	10.5
PMAC	(3.19)	(3.12)	(2.56)	(2.76)	(3.14)	(2.98)
Proficiency	9.9	11.1	8.8	11.3	11.1 *	9.3
PMAC	(2.99)	(2.69)	(2.07)	(2.95)	(3.12)	(2.58)
% Correct	10.5	10.9	9.8	11.7	11.4	9.8
PMAC	(3.00)	(3.21)	(3.03)	(3.07)	(3.14)	(2.86)

In this table, only PMA constant scores are shown.

* Significant at the .05 level. ** Significant at the .01 level.

Perception of ambiguous stimuli

We found no relationship between a child's membership in a particular differential ability group and his tendency to perceive easily a particular kind of stimulus material. That is, high-verbal children do not perceive letter-stimulus materials earlier (or more accurately) than do high-number of high-space children; and high-verbal children do not perceive letter materials more accurately than they perceive numerical or spatial stimuli.

The question remains as to whether children in any of the groups were more accurate perceivers under these low-time-exposure conditions, regardless of the nature of the stimulus material being presented. For girls, there was no tendency for children of any particular cognitive ability group to perceive better than the other groups. For boys, an analysis of variance among the mean "correct perception" scores for the original six groups studied was significant at the .01 level, with the low-verbal boys being the most accurate perceivers, and the low-number boys being the least accurate. It should be noted, too, that boys are more accurate than the girls ($p = .05$) in terms of their total correct perception scores.

We were not able to make use of our guessing score, for nearly all the children were able to perceive some part of the stimulus on the first trial, and made a guess; hence, no differentiation was possible with respect to earliness of guessing.

As previously mentioned, we assumed that a person who is intolerant of an ambiguous situation will be less inclined to change a tentative guess or hypothesis, even though it is wrong. We calculated the number of "shifts" or changes in percept, for each of our groups. As Table 5.12 shows, there are no differences among our groups in this measure of "tolerance for ambiguity."

An another possible measure of this same trait, we noted how early the children said they were "sure" of their judgments. The results are of borderline significance. For both sexes it was the high-number children who held off their judgments of "sure" until later trials, and the high-verbal children who tended to make such judgments early. For the sexes combined, the differences between high-number and high-verbal children is significant (.05), but an F-test for the variance among the means of the three "high" groups does not reach this probability level. We must, therefore, regard these results as merely indicating a tendency for the high-number children to "tolerate the ambiguity" of not being sure in their judgments than high-verbal children.

Sex differences

In this section, we will present two sets of findings. First, we will show how the boys and girls in our study differed in their performance on the various measures we employed. Then we will discuss the relationship between the child's pattern of abilities and his scores on our personality and performance tests, and how these relationships differed for the two sexes.

Table 5.13 shows the means, standard deviations, and t-tests for the comparison of the sexes on those variables for which we obtained significant sex differences. On our measures of aggressiveness, we obtained sex differences which are consistent with those generally

Table 5.12. Means and standard deviations: measures of perception of ambiguous stimuli. Differential abilities groups.

	Verbal		Number		Space	
	High	Low	High	Low	High	Low
Perception of stimuli presentedted briefly in a tachistoscope						
Mean correct perception						
Boys	18.4 (5.4)	20.0 (6.2)	19.2 (5.8)	17.3 ((4.9)	19.1 (5.7)	19.4 (5.4)
Girls	18.3 (4.3)	17.0 (5.3)	16.4 (5.4)	15.9 (7.1)	16.0 (5.7)	17.3 (3.8)
Me						
Mean shifts						
Boys	16.1 (5.2)	14.7 (4.0)	16.2 (5.0)	16.4 (4.6)	14.6 (4.3)	15.7 (5.8)
Girls	15.7 (3.8)	18.1 (4.0)	16.5 (3.8)	16.6 (4.1)	19.0 (3.8)	16.7 (3.8)
Mean "sureness"						
Boys	26.1 (7.9)	25.00 (5.7)	21.4 (6.3)	24.2 (8.2)	24.7 (6.5)	23.0 (7.4)
Girls	25.7 (6.1)	22.7 (6.8)	22.2 (4.9)	22.8 (7.8)	21.4 (8.0)	23.5 (6.2)

For boys, the t-value for the difference between the mean "sureness" score of the high-number and the high-verbal boys is 2.19. For girls, the t-value is 1.80.

Table 5.13. Sex differences. Means and standard deviations.

Variable	Boys	Girls	t	p
Aggression anxiety	54.21 (8.63)	58.50 (6.45)	3.06	.01
Anti-social aggression	16.46 (4.06)	13.54 (3.46)	4.32	.01
Dependency on adults sick, alone, afraid	14.19 (5.31)	17.41 (4.58)	3.60	.01
Derogation of dependency	21.99 (4.76)	19.34 (3.65)	3.40	.01
Sex role acceptance	(8.69 (1.19)	6.70 (2.10)	6.63	.01
Toby Tyler interpersonal	207.07 (44.73)	224.82 (46.31)	2.77	.01
Gottschaldt: total correct	24.64 (10.43)	19.32 (10.30)	2.85	.01
Mirror drawing: total performance	207.73 (24.86)	185.29 (39.91)	3.83	.01
Correct perception: ambiguous figures	18.90 (5.66)	16.84 (5.29)	2.07	.05
Blindfold test: total error	29.00 (2.25)	31.34 (4.71)	3.64	.01

Figures in parentheses are standard deviations.

reported in the literature: boys reported more feelings of anti-social aggression on their self-report scale, and girls reported more feelings of anxiety over aggression. It may be of some interest that there was not a significant difference between the sexes in aggressiveness as it was reported by our sample children's classmates in the Peer Nominations Inventory. This similarity of the sexes may have resulted from the fact that in the PNI procedure, each child in the classroom rated only the other children of his own sex, so that no rater was asked to compare the sexes, and children probably employed a within-sex frame of reference in deciding whether to check another child as someone who "gets into arguments," "makes fun of people," "doesn't back down," etc. Another possible reason for the lack fo distinction between the sexes in PNI scores on aggression is that the children were taken in a classroom setting where the amount of aggression is quite low. Still, there was enough range in the amount of aggression reported so that this variable could correlate with other measures taken in the study (e.g., a child's highest ability area). So the absence of sex differences is not solely a function of restriction of range in the PNI measures of aggressiveness.

With respect to dependency, we find that boys are somewhat more inclined to derogate dependent behavior when it is displayed by others, and girls more often report that they would seek help from adults when sick, alone, or afraid. Furthermore, in recalling the content of the Toby Tyler movie, girls correctly answered more of the interpersonal items than did boys. The literature on sex differences in dependency is not entirely consistent. Studies of pre-school children have not consistently found girls to be more dependent than boys, stereotypes to the contrary notwithstanding. Yet, on personality inventories and interest schedules administered during later childhood and adulthood, girls fairly consistently report higher affiliative needs and greater interest in interpersonal content than do boys. Our results are consistent with these findings.

As previously mentioned, the girls in our sample were less accepting of their sex role than were boys. There was a sizeable minority that wished to be boys, and asserted that boys had more interesting lives while boys very seldom expressed any preference for girls' activities or any wish to be girls.

The boys in our sample were more skillful on the Gottschaldt Figures than the girls. This is consistent with previously reported findings on greater field dependence in girls (Witkin et al., 1954; Witkin et al., 1962). The boys were likewise more proficient at Mirror Drawing, at perceiving accurately under the ambiguous conditions of brief tachistoscopic presentation of stimuli, and at spatial localization while blindfolded.

Now let us examine any sex differences in the way a child's high-ability grouping is related to other characteristics. High-number boys and high-number girls share a number of characteristics. Both are sociable (in the sense that they are rarely nominated as "withdrawn" by their peers) and they are both quite willing to acknowledge dependent impulses toward their parents when they are in anxiety-producing situations such as illness. High-number children of both sexes tend to be able to resist distraction (although this relationship is significant only for girls), and are satisfied with their respective sex roles. But there are some interesting contrasts between high-number boys and high-number girls: the boys are fairly aggressive (are nominated as "good fighters" by their classmates), while the high-number girls tend to be low in aggression, and rated as "likeable" by their classmates. The high-number girls also obtained high scores on our "anticipation of punishment for dependency" scale. From this pattern of relationships we surmise that the high-number girls are good peer group members, perhaps partly as a consequence of having been detached by their parents from excessive dependency at home, and that they are well sex typed in that their interaction with their peers is of a sort that is appropriate for girls: active but not aggressive. High-number boys are also good peer group members, but they display an aggressive pattern of interaction more appropriate for boys. And the high-number boys possess certain characteristics that their female counterparts do not share: they are unusually creative, and tolerant of ambiguity (in the sense of being able to wait a relatively long time before making a judgment of "sure" about their perception of ambiguous stimuli). These two facts suggest a certain freedom from anxiety on the part of high-number boys.

High-verbal boys and girls have little in common. It is true that they are both relatively distractible (significant only for girls), but here the similarity ends. High-verbal boys do not have many characteristics which distinguish them from the other boys in our sample, except that they obtain fairly high scores on the self-report scale of Anti-social Aggression, and report that they would not seek help from their parents when sick, alone, or afraid. There is thus meagre evidence here for a possible inference that these boys may be in a state of conflict over their relationship to authority, specifically that of their parents. The high-verbal girls, on the other hand, can best be described as a group who are still quite dependent on their parents, but comfortably so. They score low on the "derogation of dependency" scale and low on "anticipation of punishment for dependency," and these facts suggest a fiarly high but unconflicted dependency toward parents. This dependency seems not to have transferred to the school situation, for the high-verbal girls are very seldom nominated by their classmates as children who will show off in class to get attention. The high-verbal girls are relatively low in masculinity, and high in aggression anxiety, which suggests that their aggressive impulses have been quite thoroughly socialized, perhaps in the service of maintaining a close dependency bond. The high-verbal girls are the most creative (in terms of total scores on the measures of divergent ability) of the sample groups of girls, which suggests that whatever anxiety has been produced in the course of controlling their aggression has not been of a sort to produce generalized constriction of intellectual functioning. These girls do show a few deficits, however. As previously mentioned, they are distractable and they are also quite poor in mirror drawing -- a fact which probably stems from our having selected those high verbal girls who were also poor at either number or spatial tasks. Mirror drawing proved to be a task in which spatial ability is an asset. In summary: high-verbal girls are not especially active as peer group members, perhaps because they are still so closely bound with family ties but neither are they conspicuously withdrawn from peer interaction. There is some reason to believe that high-verbal girls are freer of conflict than high-verbal boys.

The principal difference between the high-space boys and the high-space girls has already been noted in the section on sex typing. While high-space children of both sexes are relatively withdrawn from peer interaction the high-space boys are passive, unaggressive, low in "mastery," and low in acceptance of their sex role, by comparison with their peers, while the high-space girls tend to be masculine and to have less than the usual amount of anxiety over aggression (for girls). We see then that high-space ability is associated with traits that are inappropriate for the sex of the child. We suspect that in part this finding is a function of our having selected as high-space children only those who were also poor at either verbal or number tasks -- possibly it is the deficit in these abilities, rather than the high level of space ability, that is associated with poor sex typing. This point has been more fully discussed elsewhere. In any case, for our sample, it remains true that the high-space boys are passive and unagressive while the high-space girls have opposite tendencies.

If we consider jointly the sex differences in the way the three ability areas relate to personality characteristics, we may note that aggression is the trait which has the most different correlates for the two sexes. For boys, aggressiveness is associated with high-number ability, and goes along with creativity, ability to shut out distraction, and close peer relationships. And for boys, a low level of aggressiveness is associated with high-space ability, as well as with ra[illegible]er weak peer relationships. For girls, aggressiveness has quite a different place in the pattern of traits: it is associated with high-space ability, and with weak peer relationships and low creativity, while it is the relatively unaggressive girls who are found in the high-verbal and high-number groups -- the groups where the more creative and the most sociable girls are found. Our data do not permit us to explore this issue further, but the implication that the control of aggression has a quite different relation to intellectual functioning in the two sexes is intriguing and worth further study.

CHAPTER VI. SEX TYPING AND SEX ROLE ADOPTION IN RELATION TO DIFFERENTIAL ABILITIES

Roberta M. Oetzel

Background and hypotheses

Measures of sex role behavior were included in the study in order to investigate the relationship between the acceptance and performance of sex roles and the patterning of cognitive abilities. The cultural stereotype of girls being good in verbal tasks while boys are good in mathematics and science might suggest that boys and girls would differ in their performance in intellectual tasks as a result of acceptance of appropriate sex role behavior. Or conversely, there is the possibility that initial skill in a characteristically "masculine" or "feminine" area of ability would predispose the child toward other behavior characteristic of these sex roles.

Before making predictions about which groups will be high on sex role performance, it is necessary to review the literature on sex differences in intellectual abilities to discover whether stereotypes are borne out in actual differences in intellectual performance.

Studies of young children indicate a small but consistent difference in favor of girls in verbal tasks of all types. Girls are superior in age of first speech (Terman, 1952; Gesell, 1940), and their speech articulation is superior during the pre-school years (Irwin, 1946; McCarthy, 1930; Beller, 1962; Wellman, 1931). During these years girls excel in verbosity, length of statement, vocabulary, and grammar (Jersild, 1938; Young, 1941; McCarthy, 1930; Smith, 1935; Day, 1932; Anastasi 1952; Davis, 1937). Many of the differences reported in these studies do not reach statistical significance, but the consistency of the findings suggest a real, though small, difference. The only study which does not report differences in favor of girls is that of Templin (1957).

When we look at verbal skills in older children the pattern changes. Girls remain superior in articulation up until age seven when all but one or two percent of both sexes have reached adult standards of articulation (Yedinack, 1949; Davis, 1937). Thereafter, studies have not been reported in the literature. Girls also remain superior in verbosity and verbal fluency into adulthood (LaBrant, 1933; Havighurst, 1947; Hobson, 1947; Herzberg, 1954; Trumbull 1953; Lindzey, 1953). The differences in grammar and spelling remain consistent through high school as well according to most of the studies in the literature (Clark, 1959; Heilman 1933; Stroud, 1942; Book, 1928; McGuire, 1961; Wesman, 1949). In reading comprehension girls are superior in the age at which they learn to read and in general reading ability through grade school (Yedinack, 1949; Monmouthshire Ed. Committee; Bennett, 1938; Anderson, 1957; Hughes, 1953, Stroud, 1942). However, there appear to be no differences in reading ability in junior and senior high school (Clark, 1959; McGuire 1961, Stroud, 1942). Vocabulary tests show that the differences between the sexes in this respect disappear earlier than reading differences. Vocabulary differences are not consistent and frequently are not significant from the beginning of elementary school at age six on up through high school (Dunsdon, 1957; Gainer, 1962; Miele, 1958; McNemar, 1942; Stroud, 1942; Clark, 1959; McGuire, 1961; Havighurst, 1947; Hobson, 1947; Herzberg, 1954; Trumbull, 1953). However, in late high school and adulthood women appear to be somewhat superior in verbal skills. Women do somewhat better on the verbal aptitude section of the College Boards, and they are superior in vocabulary in adulthood (Fishman, 1957; Miele, 1958).

In numerical skills, girls appear to have the advantage in the pre-school years in terms of learning to count and identification of numbers (McNemar, 1942; Gesell, 1940; Buckingham, 1930). However, as children begin school and actually learn the mechanics of arithmetic, there appear to be no differences between the sexes. In 11 studies of arithmetic computation which use subjects who range from six years to high school, no significant differences were found in 8 studies, two were in favor of girls, and one was in favor of boys (Woody, 1931; Clark, 1969; Stroud, 1942; Book, 1928, McGuire, 1961; Havighurst, 1947; Clark, 1959; Hobson, 1947; Trumbull, 1953; Bennet, 1959; Herzberg, 1954). From this it would appear that the early advantage of girls in counting is primarily a result of verbal facility rather than superior number ability.

If we now leave facility in computation and turn to arithmetical reasoning, the differences are hard to evaluate. In 10 studies, boys were significantly superior in three and there were no differences in seven studies (Miele, 1958; Gainer, 1962; Clark, 1959; Heilman, 1933; McNemar, 1942; Alexander, 1962; McGuire, 1961; Stroud, 1942; Bieri, 1958). No studies showed girls significantly superior. This might point to a slight superiority of boys, but this is very tentative. However, by late adolescence boys are clearly superior to women in mathematical reasoning (Fishman, 1957; Bieri, 1958; Miele, 1958; Osborne, 1954; Norman, 1953).

In spatial ability the pattern seems clearer. The few studies which have investigated differences in spatial ability at the pre-school level have found no differences (Gesell, 1940; Koch, 1954). However, by the age of six or seven a clear superiority of boys seems well established. In 16 studies using various different spatial visualization tests in subjects from six years through adulthood, 12 yielded significant differences in favor of boys and three showed no differences (Mellone, 1944; Porteus, 1918; Gainer, 1962; Schiller, 1934; Havighurst, 1945; Emmett, 1949; Lord, 1941; Havighurst, 1947; Hobson, 1947; Wesman, 1949; Janke, 1945; Herzberg, 1954; Trumbull, 1953; Bennett, 1959; Norman, 1953; Barrett, 1955). Of the three no difference studies, two were studies using the Wechsler-Bellvue block design tests. Since this test is a speed test requiring manipulation of blocks as well as spatial visualization, it is not a pure test of spatial ability. Thus, the difference in favor of boys in spatial ability seems well documented.

From these studies it becomes apparent that the usual stereotypes of girls being good at all kinds of verbal tasks while boys are superior in numerical skills does not hold up in the middle years of childhood. The primary difference seems to be that boys are superior in spatial visualization, and this is consistent at all ages after age six or seven.

The problem now becomes one of explaining this difference. It is possible that the difference is innate. However, it is also possible that spatial ability develops to a greater degree in boys than in girls because of differential experience with spatial tasks. This difference in experience might arise from differential expectations of parents as to what are appropriate activities for boys and girls. Thus, Goodenough (1957) found that parents expect girls to be more interested in people than boys are, and in a drawing situation boys drew more ojects and girls more people. McCarthy (1953) has suggested that girls are more verbal at the pre-school age because they are expected to play in the house in close relationship to the mother while boys are sent outside to play. Thus, boys might gain greater experience with spatial relations than girls. Indeed, Erickson (1951) found that in play sessions boys build more dynamic, outdoor scenes and build more with blocks than girls, while girls build more static home scenes.

Differential experience with spatial relations may be a result of other differences between the sexes rather than direct expectations of parents. Thus, if boys are more active and aggressive, they may be sent out to play more often than girls, even though parents have no direct expectations in regard to activities for boys and girls.

It was felt that perhaps the greater opportunities for exploring the world of objects and participation in specific activities such as block building and construction kits might give boys who have adopted their cultural sex role an edge in spatial ability. Therefore, it was predicted that:

Hypothesis 1. Boys and girls who were high in spatial ability would also be high in masculine role behavior.

Hypothesis 2. High-space boys would be high in acceptance of their own role.

Hypothesis 3. High-space girls would be low in role acceptance, since they have taken on a more masculine role.

No specific hypotheses were made about high-verbal and high-number children although the findings that girls are somewhat advanced at early ages in verbal ability might suggest that children high in verbal ability would be high in feminine role behavior. However, this hypothesis is very tentative since consistent differences in the verbal factor of the PMA have not been found.

It was also expected that:

Hypothesis 4. Boys, in general, would be significantly more accepting of their own sex role than girls would be of the feminine role.

Past studies have indicated that this is true. Thus, Smith (1939) found that from the ages of 8 to 14 both sexes become progressively more favorable to boys and less favorable to girls in the traits they attribute to them. Brown (1957) and Rabban (1950) found that girls are developmentally slower in establishing interests in feminine toys and occupations than boys are in choosing masculine toys and occupations. In Brown's use of the It Scale, girls preferred masculine toys in the first four grades and it was not until fifth grade that they began to prefer feminine toys and occupations.

Procedure

For testing these hypotheses, four measures of sex role typing were used. These included two self-administered scales to measure role differentiation and role acceptance and two sociometric measures of sex role behavior (Peer Nominations Inventory).

The measure of role differentiation and role acceptance were included because it was felt that there are two possible alternatives for those whose behavior is appropriate to the opposite sex. One of these is to reject his own sex role altogether, and the other is to refuse to acknowledge differences between the sexes.

The sex role differentiation scale was constructed to determine whether the subjects had made distinctions between activities which are associated with boys and those appropriate to girls. The items consisted of 26 activities that boys and girls engage in, and each subject was requested to state whether he felt that boys or girls, or neither sex, is better at or likes to do each activity better. After pre-testing any item which was so sex typed that it did not give a distribution of different answers was dropped from the list (for example, playing baseball). Any item which did not show a positive correlation with total score on the scale for at least one sex was dropped. The final scale consisted of 21 items. Score on the scale was the number of activities which the subject associated with either boys or girls. Scoring did not distinguish between whether the sex the activity was attributed to was masculine or feminine since the scale was designed to measure awareness of sex differences rather than appropriateness of sex typing.

The scale designed to measure sex role acceptance consisted of a series of questions in which the subject indicated preference for one sex role or the other. He was also allowed to indicate that both roles were equally attractive. Since the object of this scale was to indicate how much the subject had accepted his own role, the items were scored according to the number of like-sexed preferences the individual indicated. A boy received two score points for a like-sexed preference and one point for an indication of no preference. A girl received two points for a feminine role preference and one point for a response that the roles were equally attractive. The items are included in Appendix Ie.

As a measure of sex typed behavior, two independent scales were made up to measure masculine and feminine role behavior. Independent scales were used because it was felt that a child could learn elements of both masculine and feminine roles, and that the two kinds of behavior are not necessarily polar opposites. To achieve separate measurement of masculinity and femininity, the elements of the two roles must be independent so that different kinds of behavior are associated with each role. Using Zelditch's instrumental-emotional role descriptions, Brim found that such scales could be constructed. He also found that children could be high on both feminine and masculine role behavior. For example, girls with brothers were high in both masculinity and femininity.

For the present study, it was decided to determine empirically what behaviors children of fifth-grade age considered appropriate to each sex, rather than to use an a priori theoretical formulation of sex roles. For this purpose a list of behaviors which have been associated with sex roles in past studies was collected and presented to two fifth grade classes for rating on sex appropriateness of each activity. The items were collected from previous studies of sex typing such as those of Brim (1958) Sarbin (1955), and Terman (1936). The items were picked only if it was felt that they were things on which school children would be able to rate their peers. The items were reworded to put them on the fifth grade level. This rating sheet was presented to 52 fifth grade children and 103 undergraduates in a child psychology class. These subjects were asked to indicate whether the items were typically masculine or feminine behaviors or whether they were not sex typed. The items presented are included in Appendix Ie.

From these ratings it was then possible to pick the items on which there was agreement as to sex typing. Fourteen items were selected in this way. At least 50% of the fifth grade children agreed on the appropriate sex typing of these items, and although not all of the items appeared on the forms administered to the child psychology students, those that did were agreed upon by 50% also.

These items were then included in the Peer Nominations Inventory which has been described elsewhere in this report. A sample of children who were classmates of the children in the experimental group was used for item analysis. Correlation of item versus total scale score was run and one item was dropped from each scale because it did not correlate with total score. Thus, there were six items remaining in each scale. All of the remaining items were made into scatter plots of item against total score and a Chi-square test of non-random distribution was made. All but one of the retained items gave a Chi-square which reached at least the .10 level of significance. The items which were retained to make up the final scale were the following:

Masculinity

1. Who is never afraid of anything?
2. Who likes to show off?
3. Who likes noisy fun?
4. Who sticks up for his own rights?
5. Who is bossy?
6. Who likes to tease other kids?

Femininity

1. Who always does what the teacher says?
2. Who likes to act grown up?
3. Who is always very polite?
4. Who likes to do things for other people?
5. Who is easily embarrassed?
6. Who is careful not hurt other people's feelings?

The reliability of these scales will be discussed in the next section.

Reliability

The reliabilities of the masculinity and femininity scales were calculated by the split-half technique. The Spearman-Brown Prophesy Fromula was applied to estimate the reliability of the full scale. Kuder-Richardson Formula 21 (Kuder, 1937) was used to estimate the reliability of the differentiation and acceptance scales. The reliabilities are presented in Table 6.1.

Table 6.1. Reliability of sex typing measures.

Measure	Sex	Reliability
Differentiation	Boys	.76
	Girls	.57
Acceptance	Boys	.41
	Girls	.35
Masculinity	Boys	.87
	Girls	.82
Femininity	Boys	.73
	Girls	.81

Results

Intercorrelation of scales. Product moment correlations were determined for the measures, seperately by sex. The correlations are presented in Table 6.2.

Table 6.2. Correlations among Sex typing measures.

BOYS

		D	A	M	F
	D		.18	.23	-.08
	A	.10		.11	-.17
GIRLS	M	-.08	-.02		-.14
	F	.14	.21	.15	

D: Differentiation M: Masculinity

A: Acceptance F: Femininity

Although the moral tone of the masculinity scale seems on inspection to indicate a negative evaluation of others and the femininity scale would appear to be positive in evaluation, it is apparent that the two scales are not negatively correlated. In fact, for girls the correlation is slightly positive, although the correlations are not significant.

It appears from these correlations that masculine and feminine role behavior do not need to be polar opposites if measured independently.

Overall sex differences

When the total sample is considered, there are not significant differences on role differentiation between boys and girls. Boys and girls were about equally willing to label activities as the province of one sex or the other.

The story is quite different when role acceptance is considered. Boys were significantly (p value of .01) more accepting of their sex role than were girls (see "total" column in Table 6.3). Thus, it

Table 6.3. Means, standard deviations. Sex typing measures. Differential abilities groups.

	Total:diff. abil.sample	Verbal High	Verbal Low	Number High	Number Low	Space High	Space Low
BOYS							
Sex role differentiation	13.59	14.27	12.58	14.00	14.35	12.60	13.87
	(4.09)	(3.78)	(4.02)	(3.68)	(3.98)	(4.51)	(4.07)
Role acceptance	8.69	8.95	8.54	9.17	8.48	8.00 **	9.04
	(1.19)	(1.30)	(1.00)	(.87)	(1.30)	(1.02)	(1.20)
Masculinity-SES constant	10.44	10.23	10.29	11.43 *	9.96	9.72 *	11.09
	(2.45)	(2.40)	(3.06)	(2.99)	(2.29)	(1.87)	(2.03)
Femininity SES, PMA constant	10.61	11.00	10.21	10.43	10.96	10.44	10.70
	(2.32)	(2.68)	(1.83)	(2.08)	(2.12)	(2.17)	(2.38)
GIRLS							
Sex role differentiation	13.32	12.33	13.05	14.53	13.54	13.19	13.43
	(3.19)	(3.32)	(2.99)	(2.40)	(3.52)	(3.32)	(3.15)
Role acceptance	6.70	7.06	6.40	7.35	6.46	5.86	7.09
	(2.10)	(1.18)	(2.27)	(1.97)	(2.31)	(2.51)	(1.74)
Masculinity-SES constant	10.42	9.94	11.00	10.06	10.38	11.14	9.96
	(2.79)	(2.44)	(2.81)	(2.69)	(2.73)	(3.12)	(2.84)
Femininity SES, PMA constant	10.89	10.72	10.95	11.06	10.77	10.90	10.91
	(2.11)	(2.05)	(1.65)	(1.86)	(1.85)	(2.33)	(2.12)

* p = .05   ** p = .01   Figures in parentheses are standard deviations.

appears that by the age of ten years girls do not deny that there are differences between the sexes, but they do prefer the male role more than boys prefer the girl's role. This is as predicted, and the male role preference is consistent with analyses of sex roles in America as made by Parsons (1942) and Lynn (1959). Both authors feel that the male role is the preferred role in American culture.

The differences between boys and girls on masculinity and femininity approached significance but did not reach the .05 level. However, the larger standardizing sample yielded significant sex differences on both scales with boys higher on masculinity and girls higher on femininity. The lack of significant sex differences in the experimental sample arose from the fact that the sample boys were somewhat low on masculinity and high on femininity in comparison with the standard population of classmates.

Differences between groups

The means for the groups are presented in Table 6.3. The masculinity scale has been reported with SES held constant. The correlation of masculinity with SES was .46 in boys and .08 in girls.

Femininity is reported with both SES and total PMA held constant. The correlation between femininity and SES is -.06 in boys and .36 in girls. For total PMA, the correlation with femininity is .39 for boys and .20 for girls.

The role differentiation scale did not discriminate the groups as had been expected, since high-space girls were not lower on differentiation. There were no significant differences on this scale, perhaps because all ten-year-old children are old enough to have learned which activities are sex typed. Differences are purely a matter of individual experience.

Despite the low reliability of the scale, the differences among the groups on role acceptance were significant, although the expected results did not occur. High-space girls were expected to be less accepting of their sex role than low-space girls, and this was supported by the data. However high-space boys were also less accepting of their sex role, so that the hypothesis that high-space goes with masculine role acceptance is not confirmed.

The results of the masculinity scale are consistent with the role acceptance findings. Boys who are high in spatial ability are significantly less masculine than low-space boys. High-space girls tend to be more masculine than low-space girls, although this is not significant. Thus again the hypothesis that spatial ability is positively related to masculine role behavior is not substantiated. For boys, the high-number children were more masculine than low-number boys. For both role acceptance and masculinity, then, one can generalize the findings as follows: for both sexes, high-space ability is associated with poor sex typing.

There were no significant differences between groups on the femininity scale. Thus the tentative hypothesis that verbal children would be high in feminine role behavior did not hold up.

Discussion

When the data are analyzed, it appears that the predictions about the relation between sex role behavior and cognitive abilities were not fulfilled. The difference between the sexes in spatial ability probably does not bear a direct relationship to sex role differences as defined by culture. That is, a boy is not expected to be good in spatial tasks in order to be considered "masculine." We must lood elsewhere to find the factors important in the sex difference in spatial ability. The relationship may be an indirect one in which boys explore the world more simple because they are more active than girls regardless of the learning of cultural sex roles. Or, finally, the difference may be innate. This study does not permit a choice of alternatives, although the study on parental antecedents of high and low verbal ability has some evidence on this point. Boys whose mothers were high in permissiveness for object experimentation in early life were high in non-verbal abilities. This was not true of girls (See Appendix II).

The question raised by the findings on role acceptance and masculinity is another matter. Why are children who are high in spatial ability less accepting of their sex roles, and why are high-space girls more masculine and high-space boys less masculine than low-space girls and boys? One factor which may be important is that it is verbal and numerical ability which are rewarded in school. We considered the possibility that our high-space children are low in self esteem and self acceptance, since they were selected in such a way as to make them low in verbal or numerical skills. And possibly low self esteem generalizes to all aspects of self, including sex identity. This hypothesis can be tested, since a self esteem scale was administered to the subjects. High-space children were *not* low in self esteem, so it is necessary to look further for the explanation of the difference.

Perhaps there are other important consequences of the fact that our high-space children are low in number and verbal abilities. If the Stanford Binet Intelligence Test is thought of primarily as a test of verbal and numerical ability, then a study by Kohlberg and Zigler (1961) is relevant here. They found that high-intelligence children as measured by the Stanford Binet mental age were at a higher developmental stage on sex role identification than were children of lower mental age when chronological age was held constant. The measure of sex role learning was the It scale for Children, and the children were four to eight years old. Thus, it would appear that in this study verbal and numerical ability were associated with role identification

The important factor may be that sex role and verbal and numerical skills are learned through the mediation of other people. The child who has had rewarding relationships with significant adults has been in a position to learn the cultural sex role expectations of his society, and also to learn culturally transmitted skills. On the other hand, the child who spends his time exploring the environment at the expense of relating to other people does not learn these skills as easily, although he may learn spatial skills better than others. The high-space children in this study were low in the level of interaction with their mothers (See Bing, Appendix II), and tended to be withdrawn from interaction with classmates. Perhaps in consequence, they had deficits in verbal or numerical skills, and were also lower in sex role acceptance and inappropriately sex typed on the masculinity scale.

Since the subjects have been chosen in such a way that high spatial ability goes with low verbal or numerical ability, it is not

Table 6.4. Means and standard deviations. Sex typing measures. Normative and differential abilities groups.

BOYS

	Normative* sample	Total Diff. abil. sample	Verbal High	Verbal Low	Number High	Number Low	Space High	Space Low
Masculinity, Raw scores	16.30 (9.40)	13.66 (9.02)	12.23 (7.09)	13.13 (10.61)	17.30 (11.27)	12.23 (7.47)	11.44 (8.83)	13.61 (8.23)
Femininity, Raw scores	11.60 (7.22)	13.81 (7.37)	13.82 (8.33)	12.71 (5.66)	12.91 (6.71)	13.76 (8.94)	12.08 (7.03)	13.06 (9.30)

GIRLS

	Normative* sample	Total Diff. abil. sample	Verbal High	Verbal Low	Number High	Number Low	Space High	Space Low
Masculinity, Raw scores	13.10 (5.20)	11.00 (8.27)	9.96 (5.98)	13.60 (8.43)	10.96 (7.26)	11.46 (8.19)	14.10 (9.47)	10.43 (7.87)
Femininity, Raw scores	16.90 (8.00)	16.26 (7.36)	16.06 (6.66)	15.90 (7.33)	14.70 (7.30)	14.38 (8.28)	16.10 (7.87)	17.63 (8.10)

* The normative group for masculinity and femininity is a different sample of classmates than that used for comparison of other PMI measures. It is a separate sample of 316 boys and 372 girls.

possible to determine whether it is skill in space or *absence* of skill in verbal and numerical tasks that is associated with poor sex typing. However, another measure of spatial ability was administered to the subjects: a measure of *divergent* (or "creative") spatial ability (see Chapter VII on creativity). This measure did not show a significant negative correlation with PMA verbal and numerical ability as did PMA space. The correlations are given in Table 6.5

Table 6.5. Total Spatial Creativity.

	Girls	Boys
Total Verbal	.16	-.17
Total Number	.06	.17

If this measure does not show a significant negative relationship with role acceptance and masculinity, then we have some evidence that it is the poor verbal and numerical ability that is important rather than high spatial ability per se. The correlations are given below.

Table 6.6. Total Spatial Creativity

	Girls	Boys
Role Acceptance	-.03	-.08
Masculinity	.09	-.01

These correlations are not significant. Thus, at least with a divergent measure of spatial ability, there seems to be no negative relationship with sex typing, and the hypothesis that low-verbal and numerical ability is the important variable for the sample high-space children receives support.

Another indication of the importance of the low-verbal and numerical abilities of high-space children in relation to sex typing comes from the standardizing population of classmates for the PNI. Correlations of spatial ability and masculinity are not available, but total space score on the PMA was correlated with total aggression scores on the PNI. The aggression scale correlated .91 with masculinity in boys and .86 in girls. Thus, the scales can be considered identical for this investigation. The negative correlation of space and aggression drops out in the unselected population where low verbal and numerical scores are not contrasted with high space. Thus, one would expect the anti-sex typing of spatial ability to drop out or be much less in an unselected population.

If numerical and verbal skills and sex typing are taught in interpersonal situations then one would expect our high-space children to be low in interaction with others. They should be more withdrawn and lower in mastery and likeability. In the sample children we find that high-space boys are low in mastery and high in PNI withdrawal, although they are not low in likeability. Girls are somewhat withdrawn but they are not low in mastery or likeability.

However, in the standardizing sample, high-space children are not withdrawn (PMA constant $\underline{r}$ = .00 for boys and .03 for girls) although they are somewhat low on mastery (for boys, $\underline{r}$ = -.13 and for girls, -.19). There is a negative correlation of PMA space with likeability (for boys, r = -.18 and for girls, r = -.20) in this unselected sample.

From this it appears that there is some evidence that our high-space children are less active in interpersonal relationships, but that the unaggressive element drops out in an unselected sample where high space is not associated with low verbal and number ability. However, the negative correlations of likeability and mastery with total spatial ability in the standardizing sample suggests that there may be some remaining relationship, less pronounced but still evident, between spatial ability and lower social competence even when verbal and numerical ability are allowed to vary. The nature of this relationship is difficult to explain.

Summary. The purpose of this study was to investigate the relationship between cognitive abilities and sex role adoption. The hypotheses were:

Hypothesis 1. High-spatial boys and girls will be higher on masculine role behavior than low-spatial children.

Hypothesis 2. High-spatial boys will be high in acceptance of their sex role.

Hypothesis 3. High-spatial girls will be less accepting of their sex role than low-spatial girls.

Hypothesis 4. Boys will be higher in sex role acceptance than girls.

The basis of these hypotheses was that since boys have consistently been found to be superior to girls on the spatial test of the PMA, the cultural expectations or appropriate activities and abilities of males and females may lead to differential experience with spatial tasks. The child who is appropriately sex typed might be expected to conform to the pattern of cognitive abilities in which girls are relatively poor in spatial ability and boys are relatively high. Then, girls who are high in spatial ability might be expected to have adopted masculine interests and be less accepting of the sex roles, while high-space boys would be high in masculine behavior and thus appropriate sex typed.

Two measures of attitudes toward sex roles were given to the subjects. The first was a measure of role differentiation to measure the degree to which the subjects recognized differences between the sexes, and the second was a measure of sex role acceptance. A measure of masculine and feminine role behavior was given to the subjects' classmates for them to rate the subjects on their actual role performance. These scales were independent, so that it was possible to be high on both scales.

The results did not confirm the hypotheses. Instead, high-spatial children of both sexes showed less role acceptance than low-spatial children. Similarly high-space boys were low in masculinity and high-space girls tended to be high in masculinity. There were no differences between groups in either role differentiation or femininity.

The tentative reason given for the results was that children who are high in spatial ability and low in verbal or number skills have not had as much rewarding interpersonal relationship with the mother and other significant adults. They have spent their time exploring the environment and learning about it, but they have not learned culturally transmitted concepts such as language and numerical skills to the extent that most children do. At the same time they have not had the incentive or the opportunity to practice the roles of the adults in their world. This retards their learning of proper sex roles.

Evidence for this hypothesis was presented, and it appears that some of the relationship between sex role typing and spatial ability can be explained on this basis. The hypothesis applies to children selected as ours were -- as being skillful at spatial tasks and relatively poor at verbal and numerical tasks. However, when one deals with children who are good at space tasks and who may or may not be skillful in other ability areas, there is still some correlation between spatial ability and low social interaction.

CHAPTER VII.
DIVERGENT AND CONVERGENT ABILITIES COMPARED

Helen L. Bee

Background and hypotheses

A quantity or quality termed "creativity" is commonly contrasted with measures of general intelligence ("what the intelligence tests test") on the theory that they are relatively separate variables, i.e., that being "creative" is separate from other sorts of intellectual prowess. In recent years much interest has focused on the problem of measuring "creativity," toward the end of discovering individuals with this ability. Commonly there is a value judgment involved: that being creative is "good" and that individuals with creative skill should be trained and encouraged in much the same way that individuals with exceptionally high IQ scores are trained and encouraged. Value judgments aside, the question of the actual relationship between existing measures of IQ and measures of "creativity" is a fruitful field for research. Similarly, of late, interest has been directed at the problem of the relationship between various aspects of "general intelligence" and personality and cognitive variables. But relatively little or no attention has been given the problem of the relationship between "creative" ability and personality. This portion of the total study was aimed at adding to our knowledge of both of these relationships.

The major source of theory has been the work of J. P. Guilford. His research was originally designed to "explore abilities considered to be important in the successful performance of high-level personnel," (Kettner, Guilford, and Christensen, 1959)) with the eventual aim of predicting such performance. The procedure used was to administer a large battery of tests in an attempt to isolate relatively independent factors, each of which was important in prediction of the behavior under consideration. As a guide for the discovery of those factors, Guilford and his associates worked out a theoretical model for the total structure of intellect which considered three primary variables: 1) the operations performed, e.g., cognition, production, evaluation, memory, etc., 2) the contents, e.g., figural, symbolic, semantic, behavioral, and 3) the end product required, e.g., units, classes, relations, systems, etc. The resulting model is thus a three-dimensional one with the expectation that a different factor exists for each possible combination of types of contents, operations, and products. For example, they expected to discover a factor of the memory of semantic units (words), and one for the evaluation of symbolic classes (e.g., some variations of mathematical evaluation). The portion of this total model which is relevant to the study of "creativity" is the operation called "production." Guilford divides this operation into two sub-categories: convergent production and divergent production. They are contrasted in the following way:

> In convergent thinking, there is usually one conclusion or answer that is regarded as unique, and thinking is channeled or controlled in the direction of that answer. . . In divergent thinking, on the other hand, there is much searching or going off in various directions. This is most clearly seen when there is no unique solution. (Guilford, 1956, p. 274)

It can be seen that what is termed "convergent production" corresponds to the type of production required on most tests of "general intelligence." What is termed "divergent production" corresponds closely to what is usually called "creative thinking," or "creativity."

According to Guilford's model, parallel sets of factors are to be expected for these two types of production. Figure 7.I illustrates this.

			Content	
		Figural	Symbolic	Semantic
	Units			
	Classes			
	Relations			
Products	Systems			
	Transformations			
	Implications			

Figure 7.I.
Expected factors for both convergent and divergent production.

In the areas of both divergent and convergent production a great deal of research has been done attempting to isolate all of these hypothesized factors, but little or nothing has been done with regard to the relationship between the parallel factors in the divergent and convergent matrices. We do not know, for example, if the divergent production of semantic units and the convergent production of semantic units tend to go together. This is one of the problems to which the current study addresses itself: the relationship between convergent and divergent production.

It is true that a relationship has quite consistently been found between measures of general intelligence and measures of "creativity" or "originality." Ammons, et al. (1958), using anagram solution as a measure of creative fluency, report that "anagram solution fluency correlated significantly with a measure of verbal intelligence." (Ammons, et al., 1958 p. 87) Barron (1957), using a battery of eight "originality tests (including three of Guilford's), Rorschach, TAT, and staff observations found that the staff's observations of the subjects' verbal fluency, conversational facility, and degree of intellect were significantly related to a composite score on the originality tests.

These results do indicate a global relationship between convergent and divergent ability. But these findings deal almost exclusively with verbal ability. The possible relationship between non-verbal convergent and non-verbal divergent abilities remains largely unknown. There are several obvious possibilities:

1. There may be some sort of "g" factor of divergent ability -- i.e., individuals may tend to be "creative" across different kinds of content. If so, there may be a direct relationship between this "g" factor and a parallel "g" factor of convergent thinking.

2. The relationship between convergent and divergent thinking may be within content rather than across content; i.e., individuals skilled at verbal convergent tasks may tend to be skilled at verbal divergent tasks but not at non-verbal divergent tasks.

The sample of children used for this study, having been chosen on the basis of skill in one content area, seemed ideally suited for an initial investigation of these problems. The general procedure was to administer parallel forms of divergent tests in the same three content areas to the sample of 126 children and then compare their scores on these tests to their scores on the original convergent measures. In so doing, several assumptions were made. First, it was assumed that the three content areas, numerical, verbal, and spatial, were roughly equivalent to the three areas Guilford labels figural, symbolic, and semantic. Insofar as the kind of spatial task administered is one of the possible types of tasks falling under the category "figural," and the number and verbal tasks are similarly possible problems under the categories "symbolic" and "semantic," respectively, this assumption seems tenable. Secondly, while it was clear that an unselected sample would ultimately be required to provide any definitive answer to the questions raised above, it was assumed that the sample at hand would provide a useful starting point. It is not possible to determine completely whether any consistency is within rather than across content without an unselected sample, but this sample should provide suggestions as to the direction of any consistencies which do exist.

The main study of this sample (reported in Chapters III - V) concerns itself in part with correlates of different patterns of convergent thinking. The second main portion of the work on "creativity" was aimed at determining the equivalent correlates of different types of divergent skill. By comparing these two sets of correlates, it was hoped that two different purposes would be served. First, on a purely empirical basis, it was hoped that some understanding of the different implications for personality and cognitive abilities of divergent versus convergent skill in a given content area might be gained. Second, it seemed possible that some of the original project hypotheses might hold for divergent thinking but not for convergent. For both of these reasons correlations between the divergent measures and all of the other variables studied in the main body of the project were computed.

There were no specific hypotheses about the relationship between convergent and divergent thinking. Rather, this investigation was intended as preliminary, hopefully providing hypotheses which could then be tested with further research.

Procedure

Since measures of convergent skill were already available, the problem was that of discovering or developing tests of divergent skill. Clearly, the whole divergent production matrix (as in Figure 7.1) could not be completed. The study was therefore further limited by use of only two of the six rows. Measures were sought for the row of *classes* and for the row of *transformations*. Thus, six tests were sought: production of verbal, numerical, and spatial classes; and production of verbal, numerical, and spatial transformations. The first of these, classes, was intended as a measure of "fluency;" the second, transformations, was intended as a measure of breadth of response. In each of these, a Guilford verbal test was used as the prototype. For the verbal production of items in a class, the item, "List things that are soft, white, and edible," was used as a model, and equivalent spatial and numerical tests were sought. Similarly, the prototype for transformations was the item, "Write down all the things you can think of that you can do with a brick."

The search for equivalent numerical and spatial tests was not altogether successful. In fact, no known tests existed which fulfilled the requirements. Consequently tests were devised which, on an a priori basis seemed to suit the needs of the study. In all, nine separate pencil and paper "tests" (or "items") were administered: four verbal (two classes, two transformations), three spatial (two classes, one transformations) and two numerical (one classes, one transformations). The tests were administered in three sessions, with the children being tested in groups of size 1 to 13, all the children in a given school being tested together. The nine tests administered are listed below:

Verbal:

1. Classes -- fluency
   a. "List all the things that you can think of that are soft, white and can be eaten." (three minutes allowed)
   b. "List all the things that you can think of that are hard and black." (three minutes allowed)
2. Transformations -- breadth
   a. "Write down all the things that could bring you comfort on a very hot day." (three minutes allowed)
   b. "Write down all the things you can think of that you could do with a brick." (three minutes allowed)

Numerical

1. Classes -- fluency
   a. "Write down other groups of numbers that are like this group in some way: 4 16 64." (three minutes allowed)
2. Transformations -- breadth
   a. "Write down all the ways you can think of that you could get the number 4." (three minutes allowed)

Spatial:

1. Classes -- fluency

   a. "Make as many different drawings as you can each with four lines. Two of the lines must be the same length. No drawing may have more than four lines, and you cannot just change the size of a drawing and have it be different." (three minutes allowed)

   b. "Make as many different drawings as you can using a circle and three other lines. Each drawing must have a circle and three other lines, and you cannot just change the size and have it be different." (three minutes allowed)

2. Transformations -- breadth

   a. The following stimulus was given with the instructions, "Make a drawing using the lines on this page. It must be a drawing of 'something' and you must use these lines in the drawing." - On the following six pages an identical stimulus was presented with the instructions. "Make another drawing using these lines." (no time limit)

All of the "fluency" measures were scored for the total number of responses which satisfied the criteria given in the instructions. On the basis of this scoring the numerical "fluency" measure was discarded since the majority of the subjects gave no correct response at all. In this case most of the S's seemed to have spent the major portion of their time "figuring out" the problem. Thus, the task becomes convergent rather than divergent. As a substitute for this discarded measure, the "ways to get the number 4" measure was scored for fluency as well as for breadth.

The "breadth" measures were scored for the number of different "types" of responses, or "categories" of response that each subject gave. To obtain this measure, the total body of responses from all S's for each measure was examined and then broken down into "types" of responses. For example, in the "brick uses" problem, the responses could be divided into categories such as "building material," "weapon," "heavy object," "rough object," etc. The score given each subject was simply the number of these categories that he used.

The scores for each of the resulting 9 measures were transformed to standard scores. Where two tests of the same type were available (i.e., verbal fluency, verbal categories, and spatial fluency), the two standard scores were combined to produce one score. The final step in scoring was to combine the standard scores for fluency and categories for each of the content areas into one "total" score. In sum, then, the following measures were obtained, all in standard score form:

1. Verbal fluency
2. Verbal categories
3. Total verbal
4. Numerical fluency
5. Numerical categories
6. Total number
7. Spatial fluency
8. Spatial categories
9. Total space

For verbal and spatial material the final scores on fluency and categories (breadth) were from independent measures. For numerical material, due to the apparent "convergent" quality of the intended fluency measure, the two final scores were obtained from the same measure.

Results

The results and discussion will be presented in two main sections, the first dealing with the problem of consistency between convergent and divergent thinking and the second with the comparison of the correlates of measures of divergent and convergent thinking.

I. Across content consistency

A. Intercorrelations among the variables

The intercorrelations, for the two sexes combined, among the nine final variables (six sub-scores and three total scores) appear in Table 7.1. It is evident from this table that verbal and numerical divergent thinking, as measured in this study, are unrelated. The relationship between spatial skill and verbal or numerical is not so clear-cut. The correlations between spatial tests and the two other content areas, while not startlingly high, are generally greater than any of the other correlations, with one of them reaching significance. To the extent that spatial divergent thinking is related to both verbal and numerical divergent thinking, there is some slight evidence for a divergent "g" factor.

The second half of the question concerning a possible divergent "g" factor is whether this general divergent ability were related in some difect way to a parallel "g" factor of convergent thinking. Put another way, is there some factor of general intellectual ability which encompasses both convergent and divergent ability? A partial answer to this can be gleaned from the correlations of the divergent measures with total PMA. These correlations can be found in Table 7.2. In keeping with the findings reported earlier, it appears that a consistent relationship is found, regardless of the content of the stimulus material, between measures of convergent and divergent abilities. However, the fact that the divergent measures, although they all

Table 7.1. Intercorrelations among standard scores for verbal, numerical, and spatial fluency and breadth (categories) scores.

	V_{cat}	V_{tot}	N_{fl}	N_{cat}	N_{tot}	S_{fl}	S_{cat}	S_{tot}
Verbal fluency	.416***	----	.003	----	----	.168	----	----
Verbal categories		----	----	.007	----	----	.08	----
Verbal total			.048	.003	-.11	.07	.14	.19
Numerical fluency				.201*	----	.178	.109	.213*
Numerical categories					----	-.11	.082	-.170
Numerical total						.10	.03	.06
Spatial fluency							.07	.72***
Spatial categories								.86***

*p = .05   ***p = <.001

Table 7.2. Correlations between total FRA score and measures of divergent ability.

	Total FRA	p
Total Verbal (z score)	.283	.001
Total Number (z score)	.374	.00006
Total Space (z score)	.229	.012
Spatial Fluency (z score)	.532	<.00001

correlate with the same variable (PMA) do not consistently correlate with each other, indicates that there is not one single factor of "general intelligence" or intellectual ability which subsumes both convergent and divergent skills. Thus, while some evidence is found for a small divergent "g" factor the direct relationship between this factor and the parallel factor for convergent thinking is not found.

B. Reliability

The issue of reliability cannot be completely met. For only four of the nine final measures are estimates of reliability possible. For verbal fluency, verbal categories, and spatial fluency two measures each were available. The correlation between each of the pairs was computed and the Spearman-Brown split-half reliability formula was applied. (See Table 7.3) For total verbal, a reliability estimate was derived by determining the product moment correlation between the sum of one fluency and one category score against the sum of the other fluency and category scores. The Spearman-Brown formula was then applied. No estimate of the reliability per se of either the total numerical or total spatial "creativity" scores can be obtained. For these two measures indirect information concerning reliability can be obtained from an examination of intercorrelations among the various scores contributing to each total.

Numerical categories and fluency correlate .20 ($p < .05$) while the sum of the two spatial fluency measures correlates only .07 with the spatial categories measure. Clearly, in the case of the total space score and less clearly for the total numerical score, the component parts of the total are not measuring the same "thing." These low intercorrelations do not eliminate the possibility that the total scores [illegible] which the tests [illegible] creativity" or "divergent [illegible]." But they [illegible] suggest problems in interpreting the results. The questions becomes: Is the finding of a general absence of across subtest consistency in divergent thinking due simply to lack of reliability? There is at least one [illegible] not indicate the case. With the exception [illegible] the spatial tests [illegible] inter-correla- tively [illegible] (See Table 7.4). Thus, the lack of correlation between total [illegible] total spatial scores and verbal totals cannot be due solely to lack of reliability, since [illegible] totals are "capable" of generating significant correlations with a total [illegible]. [illegible] support for the validity of the divergent [illegible] suggested in Table 7.3. It is clear that the DT tests need to [illegible] tested using measures of known high reliability.

Table 7.5. Reliability

	r	Spearman-Brown correction
Verbal fluency (2 measures)	.388	.559
Verbal categories (2 measures)	.228	.372
Spatial fluency (2 measures)	.705	.827
Verbal total (1 fluency + 1 category score vs. the 2nd fluency + the 2nd category score)	.507	.673

In sum, [illegible] understanding that the [illegible] of the measures used is somewhat [illegible], the following conclusions were made: (1) In general, there appears to be [illegible] across subtest consistency within divergent ability. The [illegible] of a possible divergent "g" factor is found, however, in the fact that spatial divergent thinking is related to both [illegible] and verbal divergent thinking. (2) A [illegible] was found for [illegible] on tests of divergent thinking to be [illegible] related to a measure of convergent thinking [illegible]. (3) [illegible] component parts of the total are not measuring the same 'thing.' These low intercorrelations, do not eliminate the possibility that the *total* scores may be measuring some quality which one might call 'spatial creativity' or 'numerical creativity.' But they most certainly suggest caution in interpreting the results. The questions becomes: Is the finding of a general absence of across content consistency in divergent thinking due solely to lack of reliability? There is at least one indication that this is not entirely the case. Both the numerical total score and the spatial total score correlate significantly with total PMA. (See Table 7.2) Thus, the lack of correlation between total numerical or total spatial scores and verbal total cannot be due solely to lack of reliability, since both spatial and numerical totals are 'capable' of generating significant correlations with a third variable, in this case total PMA scores. While this consideration lends some support for the validity of the findings reported in Table 7.1, it is clear that the findings must be replicated using measures of known high reliability.

In sum, then, with the understanding that the reliability of the measures used is somewhat questionable, the following two points were made: (1) In general, there appears to be relatively little across content consistency within divergent ability. One indication of a possible divergent 'g' factor is found, however, in the fact that spatial divergent thinking is related to both numerical and verbal divergent thinking. (2) A consistent tendency was found for scores on tests of divergent thinking to be positively related to a measure of convergent thinking (total PMA). It was pointed out that these two findings, taken together, do not support the notion of a 'g' factor which encompasses both divergent and convergent thinking.

II. Total Divergent Ability

Before discussing the question of within content consistency, it is necessary to determine whether there is any difference between the six convergent groups on total divergent skill. If such a difference exists, it must be taken into consideration in discussing within content consistency. The relevant data appear in the last row of Table 7.4. This score was obtained by averaging, for each of the six original groups, the scores on total verbal, total number, and spatial fluency divergent measures.* F-tests were computed for the scores separately for both high and low groups. None were significant. Comparing high versus low groups for each content area on total divergent ability, two significant differences are found among the girls; high-verbal girls are significantly more divergently skilled than low-verbal girls and low-space girls are more divergently skilled than high-space girls.

III. Within content consistency

On the basis of the data from Part I above, it seemed reasonable, for further analysis, to use the verbal total score as the best estimate of "verbal creativity." Similarly, while the two parts which make up the numerical total are not as highly correlated as one might wish, the total does correlate quite highly with PMA. For this reason, and

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* Since these scores are all based on equivalent standard scores, averaging is a legitimate procedure. Spatial fluency was selected since it had a known high reliability. In discussing a total divergent score, it seemed advisable to use a score with the highest possible reliability.

Table 7.4. Means and standard deviations on measures of creativity, differential abilities groups.

BOYS

Divergent measures:	Verbal High		Verbal Low	Number High		Number Low	Space High		Space Low
Total Verbal	5.18	*	4.46	5.15		4.87	4.30	**	5.26
	(1.45)		(1.41)	(1.51)		(1.52)	(1.42)		(1.51)
Total Number	5.05		5.60	5.44	**	4.23	4.91		5.54
	(1.12)		(1.18)	(1.31)		(1.80)	(1.68)		(1.26)
Spatial Fluency	5.02		5.50	5.27		4.79	5.17		5.16
	(1.19)		(1.09)	(1.00)		(1.10)	(1.26)		(1.17)
Spatial Categories	4.83		5.50	5.06		4.98	5.15	**	4.55
	(.90)		(1.18)	(1.21)		(.79)	(1.03)		(.95)
Total Space	5.07		5.86	5.18		4.77	5.33		4.94
	(1.17)		(1.77)	(1.52)		(1.35)	(1.86)		(1.26)
Total Divergent	5.06		5.19	5.29		4.63	4.79		5.32
	(1.42)		(1.23)	(1.27)		(1.47)	(1.45)		(1.31)
Vertical F-tests									
High groups		NS			NS	2.66		2.66	
Low groups		8.83			NS	2.98		2.98	
		p = <.001						p ≈ .10	

GIRLS

Divergent measures:	Verbal High		Verbal Low	Number High		Number Low	Space High		Space Low
Total Verbal	6.13	**	4.69	4.94		5.14	4.84	**	5.89
	(1.94)		(1.63)	(1.19)		(2.19)	(1.70)		(1.32)
Total Number	5.43		4.81	5.16	**	3.99	4.19	**	5.45
	(1.74)		(1.41)	(.71)		(1.81)	(1.75)		(.74)
Spatial fluency	5.06		4.43	4.59		5.35	4.83		4.89
	(1.31)		(.61)	(.77)		(1.06)	(.89)		(1.15)
Spatial Categories	5.12		5.10	4.99		4.56	4.83		5.10
	(.70)		(.61)	(.92)		(.97)	(.96)		(.96)
Total Space	5.13		4.50	4.57		4.86	4.64		4.97
	(1.54)		(.93)	(1.00)		(1.55)	(1.32)		(1.46)
Total Divergent	5.54	**	4.64	4.89		4.83	4.62	**	5.41
	(1.46)		(1.22)	(.89)		(1.69)	(1.44)		(1.07)
Vertical F-tests									
High groups		2.93			NS			NS	
Low groups		NS			2.66			3.99	
								p = <.05	

* t-test significant at .10; ** t-test significant at .05 of better.
Figures in parentheses are standard deviations.

because there was no reasonable basis on which to choose one or the other of the two numerical sub-scores as a best estimate, the total score will be used for further analysis. The spatial scores present quite another problem. All three spatial scores will be considered separately for two reasons. First, although the total does correlate significantly with PMA, the two component parts do not correlate with each other at all ($r = .07$). Secondly, since the reliability of the spatial fluency score is quite high (.83), it seemed valuable to examine the data for that measure separately.

The data bearing on the question of within content consistency are presented in Table 7.4. The issue here is the extent to which there is matching of content skill across the two kinds of thinking -- divergent and convergent.

The simplest way of answering this question is by means of a comparison of mean scores for high versus low groups. This type of analysis will be familirr from the earlier portions of this report. The within content consistency hypothesis would predict that, for a given content area, the high convergent group should be significantly better at the divergent task than the low convergent group. Examining the data in this way it appears that for verbal and numerical contents this hypothesis is largely supported. For boys, high-verbal is better than low-verbal at the verbal divergent task at the $p = .10$ level. For girls, this same comparison reaches the .05 level of significance. For both sexes the high vs. low number comparison is significant at the .05 level or better, while only one of the six relevant high versus low space comparisons reaches significance. On the basis of this evidence alone the conclusion could be drawn that within content consistency exists for verbal and numerical contents, but only slightly or not at all for spatial content. But this is only one type of consistency. There is another equally plausible type of within content consistency analysis which involves a vertical rather than a horizontal examination of the data. In this analysis, the consistency hypothesis would predict that each high group should be significantly better at its equivalent task than at either of the other tasks, and similarly, each low group should be poorest at the equivalent divergent task. To discover the extent to which this type of consistency holds, F-tests were computed comparing each convergent high or low group on total number, total verbal, and total space divergent scores. The results of these F-tests appear at the bottom of Table 7.4.

Of the 12 F-tests, only 2 are significant, both low group comparisons. For boys, the low verbal group is significantly lower on verbal divergent thinking than on either spatial or numerical divergent, while for the high-verbal, high-number, and low-number groups, the sets of vertical scores are not sufficiently different from one another. The sets of scores for the two spatial groups both approach significance, in the direction predicted by the consistency hypothesis. For girls, the significant F is for the low-space group, again in the predicted direction, with the low-number group and the high-verbal group approaching significance. In all, only the high-space group for girls does not run in the predicted direction.

Thus, on the basis of the vertical analysis, one can say first, that the low convergent groups tend to behave more consistently with respect to divergent ability than do high convergent groups, and second, that space is no less consistent than either of the other two content areas.

There is one further form of analysis which seems necessary. To go back to the first point made in this section, it was noted that for boys the high-number group tends to be better, in general, at divergent thinking than either of the other two high groups. For girls, it is the high-verbal group which holds this position. Examining all of the mean scores in the number column for boys and the verbal column for girls, it can be seen that in both cases the high group is consistently better than the low group. We, thus, need to know not only that there is a significant difference between the high and low groups on the relevant divergent tests, but also whether that difference is greater than the other high-low comparisons. E.g. is the difference between the high-number and low-number groups on number divergent significantly greater than the difference between the high and low-number groups on verbal or spatial divergent? An F-test involving differences between the high and low groups (See McNemar, Case XVII) was computed for boys' number and girls' verbal groups. Neither was significant.

Conclusions and discussion

What does all of this add up to? Each different analysis appears to yield different results. On the basis of high-low comparisons alone, it appeared that there was greater consistency within verbal and numerical contents than within spatial. Using the vertical analysis, it appeared that the consistency pattern is different for the two sexes. For boys, verbal and spatial contents show consistency in the sense that the convergent skill "predicts" the amount of the equivalent divergent skill, while being high in convergent number "predicts' a generally high divergent skill, the skill at number divergent being not significantly greater than skill at either verbal or spatial divergent thinking. The same sort of pattern emerges for the girls, except that for them it is verbal convergent skill which "predicts" generally high divergent skill, with spatial and numerical contents showing some within content consistency.

Clearly, the relationship between convergent and divergent thinking is not a straightforward or simple one. It appears, on the basis of these data, to depend on three things:

1. The sex of the child -- The pattern of relationship between convergent thinking and total divergent is different for the two sexes. For girls, it is high-verbal (convergent) S's who are somewhat more divergently skilled. For boys it is high-number S's who hold this position.

2. The content area at which the child is convergently skilled -- In general, there is a tendency for children of both sexes to be most skilled divergently in the same content area at which they are convergently skilled.

3. General intelligence -- Regardless of content area, there is a tendency for S's to be skilled divergently in proportion to the amount of general intelligence, i.e., general convergent ability.

Further than all of this, it is perhaps worth noting that in the vertical analysis the comparison of low group scores was most productive of significant and near significant differences. This suggests the possibility that a child's poor convergent area is most predictive of his divergent performance. It also suggests the possibility that the relationship between convergent and divergent thinking is a fan-shaped distribution such that if an individual is poor at one he will be poor at the other, but being good at one may or may not coincide with being good at the other. This is a possibility that should be checked with further data from an unselected sample.

Results, Part II

IV. Divergent and convergent correlates compared

It was mentioned in the introduction that the second major objective of this portion of the total research project was to investigate the correlates of divergent thinking and compare these to the parallel correlates of convergent thinking.* In each case the three component parts of the original PMA score (i.e., verbal, numerical, and spatial sub-scores) and the three divergent scores, total verbal, total numerical, and spatial fluency, were correlated with all of the personality and cognitive variables measured in this project. Total PMA was then partialed out of all of those correlations so that the convergent and divergent correlations with any variable would be comparable. The results are presented in Table 7.5. The data presented include only those variables which correlated at at least the .05 level

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* The correlation coefficient can give only a rough estimate of these relationships. Both the convergent and divergent scores form non-normal distributions; the convergent is so by selection, the divergent scores tend to be somewhat positively skewed. However, since discrepant groups for divergent thinking were not available, comparison of means was not possible. Thus, the correlation coefficient is the only available estimate of the degree of relationship.

Table 7.5. Correlates of convergent and divergent thinking with Total PMA partialed out.

Verbal					
BOYS			GIRLS		
Variable	Divergent r	Convergent r	Variable	Divergent r	Convergent r
Femininity	.46	.15	Anticipation of punishment	-.46	-.11
PNI dependency on peers	.26	.04	Distraction, total simultaneous	.26	.06
PNI likeability	.27	-.02	Gottschaldt, weighted %	-.31	.05
PNI mastery	.36	.13	Age of child	-.26	-.20
Self-report, mastery	.25	.15	Number of children	.30	-.06
Toby Tyler, difference score	.43	-.02	Distraction, total verbal	.34	.31
Toby Tyler, interpersonal score	.34	.41	Distraction, total successive	.29	.48
Toby Tyler, stimulus score	-.20	.39	Distraction, total error	.33	.32
Stick figures, communality	.24	.39	Projected aggression	.20	.28
Gottschaldt, proficiency	-.24	-.28	Aggression anxiety	.11	.28
Story memory	.06	.23	Mirror drawing, sum error	.02	.37
Anti-social aggression	.05	.24	Mirror drawing, sum rate	.21	-.28
Dependency on adults, sick, alone, afraid	.00	-.23	DAF deterioration	.14	.28
			PNI dependency on peers	.23	-.29
			PNI attention seeking	.04	-.27

Table 7.5 (con'd). Correlates of convergent and divergent thinking with total PMA partialed out.

BOYS			GIRLS		
Variable	Divergent r	Convergent r	Variable	Divergent r	Convergent r
Verbal					
			PNI total dependency	.09	-.29
			Toby Tyler, interpersonal	.12	.49
			Toby Tyler, stimulus	.20	.33
Numerical					
PNI total dependency	-.27	-.14	BFT improvement	.29	.19
PNI dependency on teacher	-.30	-.14	BFT total error	-.33	-.38
Number of children	.32	.09	BFT distance error	-.30	-.43
PNI dependency on peers	-.27	-.23	PNI withdrawal	-.28	-.42
PNI total aggression	-.05	.26	Story memory, difference score	.22	.29
PNI good fighter	.11	.39	Delay of gratification	-.07	-.27
Sociability (self-report)	.09	.28	Distraction, total error	-.11	-.34
Dependency on adults, problem-solving	.19	.39	Mirror drawing, improvement	.09	.26
Dependency on adults, sick, alone, afraid	-.06	.35	Anticipation of punishment	.00	.27
Total dependency on adults	.03	.46	Sociability (self-report)	.09	.27
Toby Tyler, difference score	.07	.22	Restore positive relations	.02	.31

Table 7.5 (con'd). Correlates of convergent and divergent thinking with total PMA partialed out.

Numerical

BOYS				GIRLS		
Variable	Divergent r	Convergent r		Variable	Divergent r	Convergent r
Toby Tyler, stimulus score	-.16	-.40				
Gottschaldt, slow but sure	.12	-.23				
DAF total error	-.20	-.23				
Distraction, total number	-.09	-.29				
			Space			
Mirror drawing, sum rate	.24	-.01		Delay of gratification	.28	.00
Restore positive relations	-.23	.01		Distraction, total verbal	.33	-.20
Correct perception	.24	.10		Distraction, total error	.37	-.13
Gottschaldt, slow but sure	-.26	.35		BFT improvement	.26	.12
Gottschaldt, weighted %	-.10	.62		Story memory, difference score	-.37	.21
Gottschaldt, proficiency	.14	.41		PNI likeability	-.31	-.11
Gottschaldt, weighted sum	-.08	.59		Mirror drawing, improvement	-.32	.01
Story memory, difference score	-.06	.23		Mirror drawing, sum rate	.25	.11
Sex role acceptance	-.03	-.34		Mirror drawing, sum accuracy	-.25	.14
Masculinity	.04	-.33		Derogation	-.26	.23

Table 7.5 (con'd). Correlates of convergent and divergent thinking with total PMA partialed out.

Space

BOYS

Variable	Divergent r	Convergent r
PNI total aggression	.09	-.31
PNI good fighter	.07	-.23
PNI total dependency	.17	-.25
PNI attention seeking	.17	-.28
PNI withdrawal	-.12	.22

GIRLS

Variable	Divergent r	Convergent r
Correct perception	.26	-.02
Toby Tyler, difference score	-.22	-.06
~~Toby Tyler, stimulus score~~	~~.27~~	~~-.29~~
Toby Tyler, interpersonal	.06	-.41
Aggression anxiety	-.01	-.30
Mirror drawing, sum error	.12	-.27
Mirror drawing, total performance	.19	.26
Masculinity	.04	.27
PNI total aggression	.14	.24
PNI good fighter	-.06	.23
PNI total dependency	.08	.27
PNI attention seeking	.07	.25
Gottschaldt, weighted sum	.23	.27
Gottschaldt, proficiency	.20	.36
Gottschaldt, weighted %	.00	.29

of significance with either the divergent or the convergent measure. When one of the two correlations is significant, the other is presented to give sign and magnitude. For example, in the verbal content area Femininity correlates .46 with the divergent total verbal and .15 with the convergent verbal sub-score.

Since the correlates of the convergent scores have been extensively discussed in the major body of this report, the focus here will be on the differences between the convergent and divergent patterns. Additionally attention will be paid to the divergent correlates as they relate to the original project hypotheses.

The most noticeable thing about Table 7.5 is the almost complete lack of overlap between the convergent and divergent correlates. The variables listed between the dotted lines for each content area are those which correlate significantly with both the convergent and divergent measures, and of these few, several are significant in opposite directions.

For the verbal content area, it appears that what the divergent tests are measuring is closer to what was originally though of as high verbal skill than what the convergent tests measured. That is, several of the original hypotheses about the personality and cognitive characteristics of children with high verbal ability appear to hold for high divergent verbal ability but not for high convergent verbal ability. This is particularly true for the high-verbal boys. The divergent pattern for these boys includes high femininity, some dependency, greater attention to interpersonal cues than to other kinds of stimuli and high likeability and mastery. These findings tend to support two of the original hypotheses. First, there is *some* indication of dependency in these boys, as was predicted, while there is no indication of dependency when verbality is measured convergently. Similarly, the expectation that highly verbal children will be most attuned to interpersonal cues is borne out with these data with the highly significant correlation with the Toby Tyler difference score. A positive correlation with this score indicates greater attention to the interpersonal cues in the movie. Accompanying this are the significant correlations with the interpersonal score and the negative correlation with the stimulus score. No such pattern emerges with the correlates of the convergent measure of verbality. In all, the boys who are high in divergent verbal ability seem closer to the original expectations, and closer to the "stereotype" of the verbal boy.

For the vergal girls the picture is not so clear. While the divergent correlates present a somewhat different pattern from the convergent, neither supports the original expectations to any great extent. The one divergent correlate which is suggestive is the high negative correlation with anticipation of punishment for dependency. There is no indication that these girls are highly dependent, but this one correlation does indicate fairly low anxiety about dependency, as was predicted.

In the number content area there are again instances when hypotheses are supported by the divergent scores when they are not by the convergent. For boys, the divergent measure is consistently negatively related to dependency, as originally expected. This finding does not hold for the convergent grouping; in fact, quite the contrary. For girls, the convergent and divergent patterns in the number area are very similar -- an ability to use kinaesthetic cues and an absence of social withdrawal being the major similarities.

The paucity of significant correlations with the number divergent score for both sexes is worth noting. Whether this is due to lack of reliability or validity or both cannot be determined from these data.

The spatial content area is the most difficult to interpret. For boys, there is no clear pattern. The indications are that boys who are skilled at divergent spatial tasks make little attempt to "restore positive relations." On the basis of findings reported earlier in this report concerning this variable, it would seem that these boys are somewhat less "sociable" or less masterful in social relationships, but other than this there are no personality characteristics related. With one interesting exception they do seem to be more than usually skilled at kinaesthetic and perceptual tasks and seem to work quickly at this sort of problem. The exception is Gottschaldt Figures. Where all measures derived from Gottshhaldt Figures are highly positively correlated with convergent spatial ability, the correlations with divergent space are either negative or very low (non-significant) positve. The simplest explanation for this would seem to be that Gottschaldt Figures is simply another measure of convergent spatial ability. To the extent that the measures used here can truly be thought of as measuring divergent spatial skill, Gottschaldt Figures would appear not to be a measure of divergent ability. The other interesting finding for the boys is that the anti-sex typing of spatial ability disappears when a divergent measure of spatial ability is used. I.e., sex role acceptance correlates

-.34 and masculinity -.33 with the convergent measure of spatial ability, but -.03 and .04 respectively with the divergent measure. It was hypothesized in Chapter VI of this report that the anti-sex typing which does appear with convergent measures of space may not be due to any quality inherent in the spatial content area, but due rather to the fact that the children in the sample who were high-space were also either low-verbal or low-numerical. It was posited that the absence of verbal or numerical skill is an indication if inadequate socialization. Thus the anti-sex typing which appears for children skilled at spatial tasks may be a sign of inadequate acculturation or socialization -- and due to the selection procedure of subjects for this study. The fact that this anti-sex typing disappears when divergent spatial ability is considered is partial support for that hypothesis. On the divergent measures the subjects did not necessarily have discrepant patterns. Thus, to some extent this was a reasonably unselected sample for divergent ability. That is, S's high on spatial divergent are not necessarily low on either verbal or numerical ability (divergent or convergent). It seems, then, that when there is not a negative correlation between spatial ability and verbal and numerical ability, anti-sex typing does not appear. The same is true for the partial anti-sex typing of the high-spatial girls. When divergent measures are used, the positive correlation between spatial ability and masculinity disappears.

For girls, one of the more interesting findings is the negative correlation with the Toby Tyler difference score and the positive correlation with Toby Tyler stimulus score. This indicates the opposite pattern from that found with the high-verbal boys -- a tendency to attend to non-interpersonal cues more often than or to the exclusion of interpersonal cues. The original expectation was that high-number children would be the least accurate at interpersonal perception. From these data it would appear that, at least for girls, itiis the high-spatial children who are least skilled at this. Also, contrary to expectation, these children do not consistently seem to be able to utilize kinaesthetic cues to better advantage than others. They do improve on the blindfold test, but their performance on the mirror drawing was, if anything, less skilled than others'.

Discussion and conclusions

In sum the following points seem fairly clear from this comparison:

1. There is relatively little overlap between the correlates of tests of convergent and divergent ability. To this extent the two types of thinking do seem to be distinct. They not only require different skills, but either produce or attract, or characterize different sorts of individuals.

2. There is some tendency for the correlates of the divergent siills to correspond more closely than do the correlates of the convergent groupings to the original notions about personality and cognitive characteristics of children with discrepant abilities. This seems to be particularly true of the comparison of verbal and numerically skilled boys. The original hypotheses that verbal boys would be more dependent and more "feminine," while number boys would be less dependent were borne out by the divergent groups but not by the convergent. This

suggests the possibility that the popular stereotypes of verbal or numerically skilled boys are using as models individuals who are divergently rather than convergently skilled. This is not as surprising as it would seem at first blush. The stereotypes probably take as their models adults who have gone into professions which require a high degree of verbal or numerical skill, e.g., an English professor, or a mathematician. And it is also undoubtedly true that these types of occupations require a good deal of divergent skill in addition to the simple accretion of knowledge. A good mathematician must be able to work out new derivations, new formulae, etc., and these are often divergent tasks. Thus, the personality characteristics which are normally thought of in association with high-verbal or high-number people may really be characteristics associated with divergent rather than convergent skill.

CHAPTER VIII. DISCUSSION

Let us begin with description of the set of characteristics which is associated with each of our "types" of differential ability patterns.

I. Children whose area of highest ability is verbal tend to be:

- low on self-reported dependency
- dependent when observed in interaction with their mothers (they more often ask for help), although this is significant only for girls
- confident that if they do make dependent bids toward their parents (even when they don't really need help), the parents will be supportive
- distractible
- relatively quick to say they are "sure" about ambiguous stimuli

There are some sex differences in the correlates of verbality:

High-verbal boys are:
- high on self-reported aggression
- fairly high on dependency as reported by their peers

High-verbal girls are:
- low on peer-reported dependency
- high in aggression anxiety
- unlikely to derogate dependency in others
- not masculine
- able to wait for larger piece of candy
- creative (skilled in divergent tasks)

II. Children whose area of greatest ability is in numerical tasks:

- have a high level of interaction with their classmates (are seldom withdrawn)
- report they would ask for help from adults (parents) when sick, alone or afraid
- but anticipate that parents would respond negatively if asked for help unnecessarily
- are high in acceptance of their sex roles (true of both sexes)
- are able to shut out distraction
- wait till relatively late to make a judgment of "sure" in perceiving ambiguous figures

Sex differences also appear in the correlates of number ability:

High-number boys are:
- fairly aggressive (normally so)
- masculine
- generally creative

High-number girls are:
- low on self-reported aggression
- popular
- competent (on peer ratings of "mastery")
- not disrupted by delayed auditory feedback
- slightly more likely to choose small candy immediately

III. And finally, the children who are especially good at spatial tasks while being relatively poor at verbal or number, are:
- withdrawn (peer ratings)
- low in sex-role acceptance (both sexes)

Consistent with the fact that space ability is associated with poor sex typing in both sexes, we find that:

High-space boys are:
- low in mastery
- unaggressive
- low in masculinity

High-space girls are:
- masculine
- aggressive
- low in anxiety about aggression
- likely to derogate dependency in others
- likely to seek help when they encounter difficulty in problem-solving (self-report)

The picture of the boy who is better in spatial tasks than he is in verbal of numerical ones is that of an essentially passive person. The high-space girl, by contrast, is active and impulse-expressive in a rather uncontrolled way.

It is evident from this set of findings that our original hypotheses were only partially correct. Our prediction that high-verbal children would prove to be more dependent on adults than our other groups, and that high-number children would be more independent of them, receives some support at least from the observations of these children in interaction with their mothers. On the other hand, we were obviously wrong when we assumed that these differences in dependency on adults would generalize directly to relationships with peers, and make for greater sociability on the part of high-verbal children and greater withdrawal in the high-number group. In fact, it is the high-number children who are most gregarious and popular with their peers, and it is also they, rather than the high-space children, who appear to be high in mastery. We appear also to have been partly mistaken about the relationship of aggression to the various patterns of ability. The high-space girls are, as we predicted, high in aggression as well as masculinity, but the high-space boys are in fact unaggressive as well as low in masculinity. We had predicted that high number ability would be related to the inhibition of aggression, but our high-number boys are actually more aggressive, although in appropriate ways, than our other differential ability groups.

Our hypothesis that numerical ability would be related to low aggression was based on the more general assumption that it is related to relatively well developed control of impulses. Here there is some evidence that we were correct. The high-number children were significantly better able to resist distraction. They did not prove to be high on the measure of delay of gratification which we used, but we have some reason to suppose (as will be discussed later) that this measure was not related to impulse control in the more general sense which we had in mind.

Several of our other hypotheses had to do with selective sensitivity and ability to utilize various sorts of cues. In most cases, our data are inconclusive with respect to these hypotheses. There is some indication that children high in verbal ability (particularly of the divergent sort) are more sensitive to interpersonal cues, but the differences between our differential ability groups are not significant. It is only on mirror drawing, among our measures of ability to use kinaesthetic cues, that the high-space children are superior, as we predicted them to be. And it may be that the skill which is crucial here is not so much the use of kinaesthetic feedback as the ability to analyze a visual perceptual field, suppressing if necessary the irrelevant aspects of the total configuration presented, such as those related to directional orientation in the mirror drawing task or to the masking complex figures in the Gottschaldt test, at which they are also superior. In any case, the high-space children did not do better than our other groups at either delayed auditory feedback or the blindfold test, the other tasks which we though would reveal the ability to utilize kinaesthetic feedback. Again, one could argue that this is not in fact the crucial variable involved in performance on these tasks, but in any case we do not have solid evidence for the relationship of spatial ability to the utilization of kinaesthetic cues.

In view of these findings, we have found it necessary to reformulate in some detail our thinking about the relationships between the cognitive variables we have been studying and the relevant processes of personality development. To the data presented so far, we may now add what has been found in the companion studies by Bing and Nelsen, reported in appendices of this report. Dr. Bing, in her study of the socialization practices employed by the mothers of some of the children in our sample, contrasted high-verbal children with low-verbal children, so from her work we do not have as clear a picture of the home conditions which accompany the development of number and space ability as we do of those associated with verbal ability. She found that high-verbal children (by contrast with low-verbal children) had mothers who:

gave them a good deal of early verbal stimulation
allowed the child to participate in meal-time conversation
criticized the child for poor academic performance
used anxiety-arousal in training the child to be cautious
offered the child more help during the observation session
gave the child more criticism during the observation session

The total impression of the mothers of the high-verbal children was that they had a high level of interaction with their children, both in early childhood and during the middle-childhood period when the children were being studied, and that they were inclined to be intrusive -- to "push" the child and participate while he was working on problems. In general, the findings were stronger when one contrasted children who were high-verbal low-space with children who were low-verbal high-space than when the contrasting area of ability was number. Another way of putting this would be to say that the mothers of the high-verbal children were the most interactive and intrusive, the mothers of the high-space children least so, with the mothers of the high-number children occupying an intermediate position.

And a final set of data to be borne in mind as we attempt to interpret our findings are the results of Nelsen's study of Stanford freshman. In this study, students' scores on the Verbal and Quantitative sub-tests of the Scholastic Aptitude Test were contrasted. While the average male Stanford student has higher quantitative than verbal scores, and the average female student has higher verbal than quantitative, there are fairly consistent within-sex differences which show that a relatively high level of verbal ability (contrasted with quantitative) is associated with:

the student's father having died
the student's mother having died (if the student is a boy and the father has remarried)
having relatively few friends
having been afraid of the same-sexed parent during childhood
(for boys) having been punished by the mother only

Is there any interpretation which will encompass all the findings? Let us first examine the simplest explanation: that different kinds of abilities are affected in different degree by the learning opportunities provided by interaction with adults. We discussed earlier (Hypotheses, p.31ff) some of the reasons why this might be so. The "parsimonious" view that we are examining now does not posit any intervening mechanisms such as dependency or anxiety but simply states that verbal ability, among the three abilities we are studying, is the most directly "taught" in early childhood through interaction with older persons, while spatial ability develops through direct commerce with the environment with relatively little contribution being made by communication from other perceivers. Numerical thinking, we said, occupies a middle ground, with respect to the amount its development should be affected by quantitative communication from others.

Bing's findings that the mothers of high-verbal children have the highest level of interaction with their children, and the mothers of high-space children the least, provides the necessary evidence that the nature of parent-child relationships is indeed associated with a child's pattern of abilities, and in the expected direction. But this finding does not demonstrate that the effect is a direct and simple one, and, in fact there are some considerations arising from our data that lead us to doubt whether this is the case. In the first place, we should take note of the kind of verbal ability that we have found to be associated with the particular socialization history that involves a high level of parent-child interaction. Thurstone long ago identified two separate verbal factors -- a word fluency factor, and a "power" factor. It is the latter that we have used (through vocabulary and reading comprehension tests) as a basis for identifying high-verbal children. We do have in addition, however, some measures of verbal fluency in the verbal creativity scores, and these proved to be unrelated to the socialization variables measured in Bing's study. Thus, it is only "convergent" verbal ability, not "divergent" verbal ability, that could be said to grow out of a high level of interaction between the child and his mother. Then, too, the high-verbal children are not especially interactive with their peers (not so much so as the high-math children). If this can be taken to mean that they are not necessarily very "talkative" (an assumption supported by Cattell's finding of a small negative correlation between verbal GRE scores and talkativeness), then we see that their high verbal ability is quite specialized, the kind of ability that one would expect from a "bookworm." We see no reason why a high level of interaction with adults should produce a child who reads easily and frequently but is not especially talkative or verbally fluent, if the only factor involved is the direct effect of verbal stimulation. There is the further fact of the high-verbal children's greater distractability to be explained, and this characteristic does not seem to be one that would be produced directly by verbal stimulation in childhood. We therefore wish to explore a different level of explanation, one which involves consideration of the development of "ego" functions as they affect thought processes.

We begin with the assumption that thought processes differ in the kinds and in the general level of maturity of ego functions which they require. We will first describe what we mean by "maturity of ego functions," and then analyze verbal, spatial, and numerical thinking in terms of their dependence upon these functions.

In giving the background for our thinking about ego functions, we start (as we almost inevitably must, in discussing the word "ego") with Freud. Freud distinguished between "primary process" and "secondary process" thinking, pointing primarily to the following differences:

> Primary process. Governed by the pleasure principle. Characterized by hallucination of desired object. Motor discharge has the function of directly releasing tension.
>
> Secondary process. Governed by the reality principle. Heightened significance of sense organs and the input from them. Development of an active function, attention, which "meets sense impressions half way;" also of a system of notations for memory. Motor apparatus now employed for instrumental activity. Impulses for motor discharge of tension restrained, and capacity developed for supporting increased tension during the period of delay in motor discharge.

Presumably, the inhibition of immediate motor discharge to which Freud refers includes emotional discharge, such as crying or temper tantrums, as well as motor activity that is not quite so directly expressive of emotion, such as fidgeting or pacing.

Freud held that thought in the young infant was exclusively of the primary-process sort, but that with increasing maturity the individual more and more came to employ secondary-process. But some remnants of primary-process thinking would characteristically remain, in dreams, fantasies, and day-dreams. He was careful to point out that the transition from one kind of thought to the other does not occur all at once, and that the growth of secondary-process thinking does not imply the renunciation of the pleasure principle but only "a safeguarding of it," so that the individual may give up a momentary but uncertain pleasure in favor of an assured later pleasure.

Other writers have pointed to similar changes occurring with the growth of the child. Heinz Werner, in his discussion of the "syncretic" character of children's thought (Werner, 1948), asserts that in the very young child: "motor-emotional and sensory factors are blended into one another," and that with growth a progressive differentiation of perception from emotion and motor activity occurs so that "objective" reactions to external thing are possible. We assume Werner's formulation implies, for example, that there ought to be a progressive decline with age in the amount of effect of "need" on perception, although to our knowledge this has not yet been demonstrated.

While he has worked with a completely different set of concepts from those employed by Freud, we believe that some of the developmental principles enunciated by Piaget have an important element in common with the changes pointed to by Freud and Werner. (For a discussion of parallels between the two theories as they apply to the first 18 months of life, see Wolff, 1960.) Piaget has noted that certain concepts, such as the notion of conservation of quantity, seem to occur only after the child has achieved what Piaget has called reversability (Piaget, 1941). He illustrates this point with his well-known tasks in which a sphere of soft clay is squashed flat, or liquid is poured from one large container into two small ones. Initially, the young child believes that the quantity of matter has changed when its shape is changed. According to Piaget, it is only after he realizes that if the liquid were poured back into the original container or the clay pancake patted into a ball it would look as it did originally, that he can understand that the quantity of matter was not changed by the manipulations performed upon it. In short, the child must imagine the reversing of the operations that changed the material's shape initially.

Let us take another Piaget example, which may at first seem far afield, but which we believe illustrates the same basic point. Piaget has insisted upon the egocentricity of the young child, and by this he means that the child cannot take the point of view of another in a quite literal sense: he cannot imagine, for example, how a chair looks to someone who is looking at it from a different direction than he is. We would like to suggest that what is required for a child to free himself of his egocentrism, or for him to reverse the operation of squashing the ball of clay, is for him to suppress the immediate stimulus situation -- to react to the stimulus situation as it was a moment ago, or as it would be if he walked to a different place, but not as it is now. This means, at least temporarily, that the immediate stimulus situation must be transformed through intermediate processes, and some elements of the immediate situation must be disengaged altogether from the response system.

We believe there would be fairly general agreement among developmental psychologists on the following proposition: that as a child grows older, and learns more, any given response is less and less predictable from the immediate stimulus field (and we mean to include drive stimuli as part of the stimulus field). The very young child is stimulus bound to a high degree. Just as the spectator at a tennis match swings his head back and forth with each movement of the ball, the young child changes his course of action with each stimulus input: the plane that flies overhead, the sudden hunger pang, the rustling of a leaf. It is this fact that we are referring to when we say that the young child has a short attention span and is easily distracted.

The more mature individual behaves in quite a different way. He can withhold (or inhibit) response to some elements of a situation while responding to others. He can withhold response to the entire set of present stimuli while scanning his memory circuits or while performing sequential acts of reasoning employing both present stimuli and previously stored elements.

Perhaps it is because the young child cannot selectively inhibit response to someelements of a situation that he has more eidetic imagery than older people. He photographs everything with his eyes -- notices ladybugs on the undersides of leaves and tiny stones on the sidewalk; in many ways he has a much richer experience than his elders and probably does a good deal more incidental learning. So something is lost as well as gained when the individual develops away from being stimulus bound; and if the development procedes too far, one finds the proverbial absent-minded professor who is so lost in thought that he can report very little of what goes on around him. But development in this direction does, we believe, constantly take place during childhood, and at different rates in different individuals.

The reader will note that Freud's distinction between primary and secondary process or at least some elements of it, can also be conceptualized in terms of the interpolation of more intermediate steps between specific stimuli and specific responses. The notion of the development of inhibition of motor discharge of tension can be interpreted in these terms, as can the development of "attention" and the growth of the ability to delay gratification.

As our central concept in the analysis of "ego development," then, we have taken the inhibition of immediate response to stimuli, and the growth of intervening processes. Sepcifically, taking our lead from Freud, Piaget, Werner, and others, we define ego development in terms of the following elements:

1. inhibition of expressive motor discharge (as distinct from instrumental motor activity).
2. ability to delay gratification; this includes forgoing a small immediate gain for a larger later one; and also the momentary establishment of hierarchies among present needs so that the responses relevant to the satisfaction of one need will be inhibited while those relevant to another procede.
3. separation of affective and motor elements from perception.
4. response to stimuli in terms of something ogher than the totality of their immediately present characteristics (e.g., in terms of their past characteristics, their anticipated characteristics, an abstracted generic property of the stimulus or some other transformation).
5. selective deployment of attention, ability to resist distraction.
6. ability to carry out progressively longer sequential internal processes, in which each step depends on others (an in planning moves in a game of chess); this includes the maintenance of longer and longer "plans" of action.

There are several concepts which have a good deal of currency among students of personality -- "tension binding," "frustration tolerance," "impulsivity," "intolerance for ambiguity," which are clearly related to several of these elements. They involve at least the first, second, and sixth of the elements we have listed. So our concept of ego development implies that the individual of a relatively high level would have high frustration tolerance, high tolerance for ambiguity, would be able to bind tension, and would not be impulsive.

It is evident that the level of a child's ego development as we are using the term will be closely related to certain aspects of his conceptual development, especially his understanding of time concepts, for the ability to defer an immediate gratification in favor of a later one must certainly depend not only upon the child's trust in the predictability of the future, but on his clarity about future time itself.

Perhaps something should be said here concerning the relationship between the internal mediating processes (referred to in 4 above) and the inhibition of motor discharge referred to in 1. Any intellectual process would appear to require some degree of inhibition of expressive motor discharge. It is difficult to imagine anyone successfully performing abstract intellectual operations while having a temper tantrum, jumping for joy, or doing the twist. It is not impossible, however, to imagine an individual pacing the floor, chewing a pencil, or twisting a ring while engaged in problem-solving processes of a fairly high order. It is not a simple matter to point to what aspects of motor behavior are detrimental to thought. Sometimes, no doubt, motor activity can be beneficial by dissipating work tensions (the function presumably served by recess periods in school). We do not feel in a position to specify the conditions under which it will interfere and those under which it will facilitate intellectual functioning. We suspect this depends upon: (a) the degree of incompatibility of the motor elements with those involved in problem-solving; (b) the amplitude of the motor responses; and (c) the pre-existing level of arousal of the organism. Feedback from energetic motor activity involving the whole organism enlarges and complicates the total barrage of stimuli with which the organism has to deal; if such an input occurs when the individual is sluggish, half asleep, it may serve a useful arousal function and facilitate thought; but if it occurs when the individual is already fully aroused, it can prove disruptive. In any case, we assume that the inhibition of whatever motor discharge does interfere with thought is an essential element in the development of the ego functioning we have been discussing.

So far we have implied, through the use of the single label, "ego development," that the several processes we have listed are interdependent in some way -- that they develop together as a "package." It is quite possible that this assumption is not justified, and that a child may be quite mature in some of these respects and immature in others. We do not wish to commit ourselves at present to the view that the elements of what we have included in "ego development" are bound together by a single core process. In fact, we suspect that they are not. But let us defer this question and proceed to a consideration of the conditions which we believe govern the level of an individual's functioning with respect to the various aspects of ego development we have listed.

We assume that for any given child, especially in early childhood, this level is not constant. A child will not always function at the maximum level which his capacity and training would permit. Under certain conditions, such as states of tension or fatigue, he will regress to a less mature level. There is some reason to believe that the inhibition of motor discharge is weakened under conditions of tension. We know this from casual observation of people who pace the floor when tense, and the same phenomenon appears in such experiments as those by Luria (1932, pp. 54 & 55). There have been few systematic experiments on the effects of stress or tension on the other impulse-control functions we have been discussing, although parents and teachers can provide many anecdotes. A six-year-old child of our acquaintance plays a reasonably good game of checkers, and can plan one or two moves ahead, but when she played a game of checkers two days before Christmas her capacity to plan ahead was much diminished, and she fell into traps she would ordinarily have easily avoided. We assume that on the last day of school, or just before a test, or when tired, most children would be less able to shut out distraction, less able to resist an immediate temptation, less able to choose from a tray of French pastry, than they would be when they were calm and rested.

We suggest, then, that the level of ego functioning of which a child is capable, is a function of the total amount of tension to which he is subject. We do not know whether the function is linear or curvilinear. Work on the relation between anxiety and performance would suggest the latter. But speaking now only of degrees of tension sufficient to produce some decrement in functioning, we suggest that those intellectual processes which require the highest levels of ego development will be most vulnerable to tension.

"Tension" is a rather imprecise word. We mean to include a fairly wide range of phenomena in our use of this term, and specifically would include the following conditions as tension-producing: requirement to perform a very difficult task (by contrast with a task already over-learned); overstimulation, in the sense of the total barrage of stimuli being rapid, intense, or numerous; and any conditions which produce anxiety.

We assume that there are two sets of conditions which determine the level of maturity of ego functioning which characterizes an individual at any given moment. One set of conditions has to do with tension, as noted above, and temporary increases in tension could presumably have transitory regressive effects in ego functioning. The second set of conditions determining the level of ego functioning are conditions of learning -- conditions which prevailed at various points through the life-history of the individual which governed his acquisition of the inhibiting responses and mediating responses that are required for the manifestations of mature functioning that we have listed. Theoretical writing on socialization has concentrated primarily on the learning conditions which affect the acquisition of interpersonal response and motivational systems such as dependency, achievement, aggression, identification. Much less thought has been directed toward the nature of the conditions which govern the growth of, for example, selectiveness in the deployment of attention, or tolerance for ambiguity. Witkin has recently made some contributions in this area in his work on the nature of parent-child interactions which foster or interfere with "differentiation" (Witkin, 1962). While we do not feel in any sense ready to offer a general formulation concerning the learning conditions which underly the development of ego functions, we would like to offer some views about some aspects of the process.

Not all the growth of ego functions depends on the nature of a child's interactions with others. Some of the necessary learning occurs on the basis of commerce with the inanimate environment. We assume, however, that impulse control does have its origins in control of the child by socialization agents, and that impulse control functions are gradually shifted from these outside agents to the child himself. (See Bowlby, 1952, p. 53.) We see this process of transfer at work in the report by Siegel and Kohn (1959) in which it was shown that children will inhibit their own aggression when their mothers are not present, but fail to do so when the mothers are present -- as if, when the mother was present, the child was depending upon her to set and enforce the rules of behavior even though he was capable of providing his own inhibition when she was absent. Socializing agents assist the development of inhibiting functions through such admonishments as "Wait a minute," "Stop and think," "Stand still (calm down) while we figure this out." "But don't you remember last time you did that you got hurt," "There's no point in getting mad, why don't you try it this way?" -- all these being maneuvers on the part of a parent or teacher to produce the necessary moment of delay in which sequential problem-solving processes occur. We would argue that the adult who will be most successful in teaching the child the desired patterns of delay and inhibition will be the one who pays attention to what is happening to the child and how he is reacting, who intervenes with a constructive suggestion early rather than late in a frustration sequence; who paces his demands accurately for the developmental level of the child, so that he doesn't ask a very young child to wait too long; who sees to it that as often as possible the delay has a favorable outcome from the standpoint of the child. It is reasonable to suppose that the ability to bind tension -- to tolerate frustration (and this is what a child must do to resist responding to extraneous stimuli) would be related to repeated experience that such tolerance pays. One is reminded of the description in Skinner's Walden II (1951) of training children to wait for a reward. The training occurred under highly predictable conditions, in which the child had to wait at first only a very short time, then a progressively longer time, and always the waiting led to gratification. Parents are constantly trying to teach children to ponstpone a small immediate gain in favor of a larger one in the future -- teaching them to save money would be a case in point -- and this teaching should be most effective when the parents are consistent, keep their promises, and otherwise provide a predictable environment for the child.

But to return to the matter of transfer of inhibiting functions from the socializing agent to the child himself: there is a point in the teaching process in which the parent must be very active, pointing out to the child the possible courses of action and the possible consequences of these, warning about premature action, soothing the child when he becomes too tense over delay; but there is a further point at which the parent must disengage himself and encourage the child to carry out the necessary vicarious trial and error himself with a minimum of emotional support from others.

Now we would like to interpret our findings concerning the characteristics of children with different patterns of abilities in the following terms: we would like to consider what elements of mature ego functioning our three kinds of abilities require; then we would like to consider what degree of tension, and what degree of learning relevant to ego functions (impulse control, manipulation of symbols) should result from the kind of socialization experiences our different groups of children have undergone; and finally, we would like to provide links, where possible, considering in what instances a child's pattern of intellectual abilities reflects a level of maturity of certain ego functions, which can in their turn be traced to these socialization experiences.

Both reading and number tasks are sequential. They require the individual to keep in mind something already taken in and integrate it with new input. If he loses the train of thought in the middle of a paragraph he is reading, perhaps because of an external interruption, he must go back and read the paragraph over. Similarly, in doing an arithmetic problem, if he forgets how many eggs Farmer Brown's hens laid in the first week, he cannot average this number with the second week's production and must go back and retrieve the necessary information. Spatial tasks tend to be less sequential in the sense of dependence of later elements on earlier ones, and hence in this respect require a less mature level of development.

While number and verbal tasks are similar in sequentiality, there seems to be a difference between them in their requirement for the individual to postpone gratification. We have assumed that our high-verbal children have acquired their verbal skills in large part through reading. Much of the material that children read provides its own direct gratification -- it is pleasure reading, in the same sense that detective stories are pleasure reading for adults. The "canned fantasies" contained in story books constitute, in Freud's terms, one of the remnants of primary process thinking that continue to function into adulthood, and their major function is to give immediate, though vicarious, enjoyment. There is very little direct pleasure-getting in the numerical skills we measured. We would not deny that it is possible to obtain aesthetic pleasure from working out an elegant mathematical proof. But our high-number children were not yet at this level; they were simply quick at multiplying and dividing and lucid in solving arithmetical reasoning problems. We assume therefore, that most number tasks require more ability to postpone gratification than most verbal tasks do.

This is relevant, we think, to how well the two groups should do in resisting distraction. We have said earlier that both verbal and number tasks tend to be sequential, and hence require the ability to employ selective attention and shut out distracting cues. But the effectiveness of a distractor should depend upon the immediate attractiveness of the alternative. To illustrate, we may consider a child who is doing his arithmetic homework when another child walks through the window, "Hey -- can you come out and play?" Let us contrast this with the situation of a child who is in the next-to-last chapter of an exciting novel when his friend asks the same question. The first child must choose between an alternative which offers immediate pleasure and one which does not; the second child has a choice between two immediately-gratifying alternatives. Clearly, the first child must have greater ability to postpone gratification in order to say "no." High-verbal children, we think, will have learned to concentrate (resist distraction), so long as what they are working on has been "sweetened" to some extent with immediately gratifying content. But even though most verbal tasks are sequential, and hence require concentration, children skilled in these tasks may not have learned to concentrate when no sweetening has been added.

All three of the abilities we have been studying require that the subject work certain transformations upon the stimulus. But spatial tasks appear to require this to a lesser degree than number and verbal tasks. It is true that in the PMA space test the subject must imagine how a figure would look if rotated through an arc; and in Gottschaldt figures, he must break the set of the initial perceptual closure which the complex figure produces and find a new closure. These spatial tasks do both require, then, a certain detachment from, or "suppression of" (as well as analysis of), the immediate stimulus. Nevertheless the transformations are still at the perceptual level. We assume that a higher order (or at least a *different* order) of abstraction is required in the use of words and numbers. To choose opposites for words or multiplying numbers involve dealing with a quite different aspect of words or numbers than their perceived configuration on a page; it involves dealing with them as symbols, and the "meaning" of symbols is a product of past instances of experience which define categories.

Becoming an efficient reader or a good mathematical reasoner probably involves learning to pay less attention to the specifics of forms and patterns, and more to abstracting their meanings, which may account for the fact that skill in reading does not imply skill in proofreading (we suspect the relationship is negative). In terms of the sequence of development of intellectual skills, we suspect that perceptual processes involving attention to forms and patterns (and hence spatial ability as we have measured it) may be more primitive (in the sense that it ordinarily develops earlier) than the abstracting processes that are more required for verbal and numerical thinking. But we do not insist upon this point, and we recognize that at least certain aspects of the skills involved in the analytic and organized perceptions which characterize our high-space children are quite mature in the sense that they develop slowly, requiring considerable learning, and may be associated with other aspects of highly differentiated functioning (such as differentiated body image, clearer memory for past events, etc. See Witkin, 1962.).

While we have been discussing verbal and numerical thinking in terms of their similarities, they may be distinguished from one another in terms of the internal operations which they require. Once language has been acquired, the exercise of such a skill as reading requires, we suggest, mainly the evocation of passive associations. Mathematical operations, however, involve the active manipulation and combination of symbols, and this, we assume, requires more capacity for delay and focusing of attention.

These considerations lead us to the following hypothesis: among the three abilities we have studied, *number ability requires a higher level of ego development than verbal ability*. We do not know quite where to place spatial ability in this rank order. Certain aspects of performance ordinarily called spatial probably requires a fairly high level, others a low level. The fact that acting-out delinquents, who are presumably deficient in impulse control, characteristically do better on the performance sub-tests of intelligence tests than they do on the verbal and numerical sub-tests suggests that spatial ability calls for less in the way of mature ego functioning than the other two abilities. But we suspect from informal observations reported to us by people administering tests to such children that they do not perform uniformly on all the performance sub-tests -- that they have more difficulty with block design, for example, than they do with picture assembly. "Spatial ability," then, as ordinarily measured, may be a melange of some relatively mature functions and some relatively primitive ones.

Earlier we suggested that the intellectual functions requiring the highest level of ego functioning ought to be the most vulnerable to tension. In terms of our special abilities, then, this would mean that mathematical performance would be the most vulnerable to anxiety, verbal the least, and that some spatial tasks ought to be more vulnerable than others. What implications would this have? We earlier mentioned two possible sets of conditions affecting the level of ego functioning of an individual at a given time: those governing the learning of such functions (conditions permitting the acquisition of impulse control, and providing direct symbolic training), and those having to do with the amount of tension impinging upon the individual which would effect performance rather than learning. Let us assume that the first set of conditions have been held constant; that is, let us imagine two sets of individuals who have had equal learning opportunities; if one set is superior in numerical tasks and the other in verbal, our hypothesis would lead us to infer that the high-math group was subject to less tension. To put it another way, if an individual's life situation produces a chronically high level of stress, he has a better chance of performing well in verbal tasks than in numerical ones.

Is there any evidence that anxiety or some other form of tension does affect different abilities in different degree? There is some clinical evidence, cited by Mayman, Schaefer and Rapaport (1951), that some aspects of verbal ability are the least vulnerable to stress. They say: "Of all the intelligence test scores, the Vocabulary score is usually the last to reflect impairment by maladjustment . . . In almost all clinical cases, it is the vocabulary score from which the premorbid level of intelligence development can best be inferred. The remaining scores show greater or lesser vulnerability to maladjustment." A study by McCandless and Castenada (1956) finds that scores on the Children's Manifest Anxiety scale generally correlate negatively with achievement scores, but that their negative correlation is *greatest* with arithmetic. As to spatial ability, which we would have to predict would be the least disrupted by tention (since we have said that it requires the least mature level of ego-functioning), the evidence is unclear. Granick (1955) compared some mildly emotionally disturbed children with normal children with matched IQ's, and found that the disturbed children did less well in block design tasks, and in the reproduction of designs from memory, while there was no difference between the two groups in picture arrangement, cube construction, and digit symbol tasks. The report did not present data concerning the relative performance of these groups on verbal and numerical tasks. Using adult subjects, Calvin et al. (1955) found that Manifest Anxiety scores correlated more strongly with certain sub-tests of intelligence tests than with others. The correlations most relevant for our present discussion are these:

Vocabulary: -.29
Arithmetic: -.31
Picture arrangement: .13
Picture completion: -.09
Block design: -.48
Object assembly: -.29
Digit symbol: -.11

The results of these two studies are consistent in suggesting that anxiety interferes more with block design than with picture arrangement. In the Calvin study, some sub-tests which we might have assumed require spatial ability are more closely associated with anxiety, others less so, than are verbal and number test scores.

It should be noted that in the Calvin study, arithmetic is *not* more negatively related to anxiety than vocabulary, which it ought to be according to our hypothesis and according to the evidence of other researchers cited above. Possibly it is the age of the subjects that is crucial here: Calvin's subjects were adults, for whom arithmetic may be overlearned to the point where it no longer requires the same kind of focusing of attention that it requires in younger children. In any case, our hypothesis and some of the evidence cited suggest that we ought to expect that our high-verbal children have been subject to more tension-producing conditions during their life-histories than the children in our other groups. We will return to this in a moment, but first we wish to consider the socialization experiences of our special abilities groups in terms of the learning experiences they provided for the development of ego functions, as well as in terms of the degree of tension produced.

We mentioned earlier that the kind and amount of a young child's interaction with his parents ought to be important in both the direct acquisition of symbolic contents (especially verbal ones), and in the acquisition of impulse control. In connection with the latter process, we described successive phases, in which the parent first participates very actively in the controlling functions, and then at a later point transfers these to the child.

We would like to suggest that in the case of our high-space children, the highly interactive phase of training for impulse control did not occur to a very high degree in the first place; that for our high-verbal children, it occurred, but the parent did not adequately carry out the later step of disengaging the child and transferring the controlling functions to him; while in the case of our high-number children, this last step had been more cuccessfully carried out. Dr. Bing's findings that the parent-child interaction was currently most intense for the high-verbal children, and least so for the high-space ones, would be consistent with this interpretation, as would our finding that the high-verbal children were the ones who most often expected that their parents would give help whenever the child asked for it, even when it wasn't really needed. We may also find some support for our position in Sanford's (1943) finding that while the parents of both high-number and high-verbal children exercised tight control over their children, the parents of high-space children did not. While the children in that study ranged in age from 5 to 14, most appear to have been at the younger end of this range, and we infer that their high-number children were still being subjected to fairly intensive training (had not yet been released from control as fully as the high-number children in our study), while the parents of the high-space children were following a fairly laissez-faire policy with their children even at this earlier age. In terms of Schaefer's circumplex model (1959), we judge that the child rearing practices of the parents of our high-space children would be at the autonomous end of the autonomy-control dimension, and perhaps somewhat toward the hostile end of the love-hostility dimension -- in the region where Schaefer locates "ignoring" and "indifference."

We are suggesting that the low level of interaction with their parents which seems to have characterized the life experience of high-space children had too effects: it may have facilitated the development of spatial ability directly, for the child must have played by themselves a good deal and been free to wander farther from home than the other groups of children.* We assume that intensive commerce with the natural environment is a more important facilitator of spatial than of number or verbal abilities, and that it permits the rapid development of those aspects of ego functioning which involve operations directly on the perceptual field. On the other hand, we assume that the lower level of control by and interaction with parents means that these children have progressed at a slower rate in the development of those ego functions which presumably depend initially upon such interaction: impulse control and some aspects of abstraction and the manipulation of symbols. We suspect they have also failed to learn certain necessary social skills which ordinarily are initially learned from and with parents. While we recognize that too-long-continued dependency of the child on adults will interfere with the child's social relations with peers (See Marshall and McCandless, 1957), we believe that there are certain social skills (e.g., listening to others, sharing desirable objects, taking the point of view of others) that are acquired in early parent-child interaction and transfer positively to peer interaction at a later time. An additional item of social learning that is of importance is to understand the expectations of others concerning the nature of the behavior that is appropriate for the sex of the child. We believe that our high-space children were less mature in respect to all these qualities that normally grow out of intensive early interaction with parents, and that it is this immaturity that accounts for their low level of interaction with peers. Success in peer-relations at the fifth grade level requires a fair degree of appropriate sex typing, impulse control, and attention to the needs and wishes of others, as well as visible academic competence. Our high-space children (chosen, it must be remembered, because they were also poor in verbal or number tasks) lack several of these requisites. Our high-space children of both sexes are poorly sex typed, and they tend to be weak in major academic subjects, which call upon verbal and number abilities more than they do upon spatial abilities. When it comes to impulse control, the situation is different for the two sexes. The high-space boys are low in assertiveness, and lack normal aggressiveness; in other words, they tend to be passive. The high-space girls tend to be aggressive, somewhat dependent, to have little anxiety about aggression. (We have evidence from other studies that neglectful-permissive socialization practices are associated with just these two different personality patterns in the two sexes. See Sears, Rau, and Mlodnosky, 1963.) The high-space girls, then, are more impulsive than the high-space boys; but assertiveness and moderate aggressiveness are more required for satisfactory peer-group relations for boys than for girls, so both the passivity of the high-space boy and the aggressiveness of the girls probably stand in the way of their social interaction with peers.

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* Bing found that the high-space boys had had more "permissiveness for object experimentation" than the other groups of children.

We see the high-space children, then, as immature in a number of respects, but we do not see evidence that they are subject to any especially great degree of conflict or tension. We do, however, see evidence of conflict in the case of the high-verbal children. These children, as we have seen from Bing's study, are the ones most subject to maternal intrusiveness and demands for achievement and conformity. We assume that the high level of interaction with his parents has facilitated the high-verbal child's development at an earlier age, but that it now interferes in some respects. Let us consider the high-verbal child's poor performance under distraction. We believe that the parents of our high-verbal children may have directly interfered with their children's development of resistance to distraction. If one wished to teach resistance to distraction specificually, one could proceed by "crowding the threshold" -- that is, by introducing weak extraneous stimuli while a child was working on a truly absorbing task, and then gradually increasing the intensity and attractiveness of the extraneous stimuli but maintaining the greater attractiveness of the central task so that the child would be practicing ignoring the extraneous cues. It looks as though, on the contrary, our high-verbal parents were constantly presenting their children with extraneous stimuli which the children would not dare to ignore, namely, the parent's own intrusive participation in the task. The high-verbal child, then, instead of being trained to ignore interruptions, would learn to expect them and depend upon them -- to stop in the middle of his work and wait for a suggestion or some other stimulus from outside.

It should be noted here that the high-verbal children's greater susceptibility to distraction may be related to the nature of the distracting stimuli we employed. If the above analysis is correct, they ought to be particularly vulnerable to distraction by the human voice -- perhaps especially by an adult female voice. Lance Canon's study

(See Appendix IV) has shown that the effect of a distractor does indeed depend upon whether it is personal or impersonal, and that the salience of these classes of distractors interacts with the nature of the motivation that has been aroused in the individual. He found that the arousal of motivation through social isolation increases the saliency of a personal (human voice) distractor. Thus, distraction by personal stimuli (the sort we employed) is related to the level of dependency motivation, and our high-verbal children might be expected to be especially susceptible to this kind of distracting cue.

This is one way to interpret the high-verbal children's susceptibility to distraction. Another interpretation involves reference to the effects of stress. A primary effect of stress appears to be to reduce the individual's ability to organize a complex array of elements. We know that anxiety interferes more with complex tasks than with simple ones (Taylor & Spence, 1952; Korchin & Levine, 1957), and that anxiety reduces incidental learning (Bursill, 1958). When we subjected our subjects to distraction conditions, we increased the complexity of the barrage of stimuli which they had to organize; the performance of our high-verbal subjects deteriorated more under these conditions, and this fact would be consistent with an interpretation that these children were characterized by a greater pre-existing level of tension. Is there any reason to believe that this is so? In the first place, we believe it to be highly likely that close maternal control over the high-verbal children would be likely to create conflict in the children in the middle childhood years when peer relations are so important, and when excessively close ties with parents are likely to interfere with these relations (See Marshall and McCandless, 1957.). But we have some direct evidence of the relationship between verbal skills and tension or conflict. There are the findings from Nelsen's study showing that fear of the same-sexed parent is associated with a large verbal-over-quantitative discrepancy in aptitude test scores. Furthermore, the death of the child's father was associated with relatively high verbal scores. And among the small group of boys whose mothers had died and fathers remarried, verbal scores were also relatively high. We take this last finding to be fairly direct evidence for relatively high verbal scores being symptomatic of stress, for Rosenberg (1962) found, in a study of broken homes and the emotional development of adolescents, that the children whose fathers had remarried had the lowest self-esteem, the highest number of psychosomatic symptoms, and the highest incidence of depressive affect of any group studied. Rosenberg found, in other words, that acquiring a stepmother is a stressful condition; Nelsen found that it tended to be associated with high scores on verbal tests (relative to scores on quantitative tests), and we believe this finding strengthens our imputation of a greater level of tension in high-verbal children.

Another possible symptom of conflict in our high-verbal children is the discrepancies between their self-reports and the other information we have concerning their characteristics. High-verbal boys obtain fairly high scores on our self-report scale of anti-social aggression, while their classmates see them as quite unaggressive. And high-verbal children score low on the self-report dependency scales, yet they are the ones who most often ask for help in the observation situation. We suggest that the self-report scores of high-verbal children (particularly boys) may reveal that they would like to be less dependent, and more assertive (aggressive) than they are -- that they would like to break away into greater independence from maternal ties. We are reminded of Ann Roe's finding that people in the higher-verbal-than-quantitative professions tend to report a history of greater conflict with their parents than do people in the more quantitative professions. We are suggesting that the conflict over autonomy which is precipitated in high-verbal children by the inability of their mothers to let them function independently engenders a state of tension which interferes with certain specific intellectual functions (such as the ability to hold in mind sequential steps of a problem while inhibiting response to extraneous stimuli) and that these functions are usually required to a higher degree for numerical than for verbal thinking.

Our tentative diagnosis of the high-number children we studied is, as mentioned earlier, that they have achieved in some respects the highest level of ego development among our three groups. Our diagnosis is based in part upon the fact that these are the children who are least distractable, and who wait longest before saying they are "sure" about ambiguous stimuli. We should note, however, that these children are not characterized by any sort of generalized inhibition of impulse. The high-number boys are more aggressive than either the high-space or high-verbal boys (although not excessively so by comparison with unselected classmates). They are evidently quite active physically (Sanders' study showed this for college students, and we infer it from the high level of social interaction our high-number boys have with their peers). And the high-number girls are the ones who slightly more often chose the small piece of candy immediately, rather than waiting for a larger piece later. (This difference did not quite reach the .05 level of significance.)

Let us digress for a moment to consider this last finding. The non-delay response to Mischel's candy test has sometimes been interpreted as revealing a lack of trust in others, and this is certainly a possible interpretation in this instance. But considering the gregariousness and popularity, it is hard to see our high-number children as suffering from any generalized distrust of other people. But there are other possible interpretations. Mischel has noted that among American children of this age, their response to the candy test is largely a function of whether their parents insist on their brushing their teeth immediately after eating candy. It would be reasonable to assume that the parents of the high-verbal children are more likely to have and enforce such rules, considering their closer involvement in the child's daily activities, and furthermore, the high-verbal child might feel less free to disregard such parental demands. Another possibility is that the high-verbal children, being more oriented toward pleasing adults and interacting with them, would have been more likely to want the experimenter to come back, and would have chosen the large piece later in order to maintain contact with an adult who had become familiar and supportive. But all this is highly speculative. We simply wish to indicate that we do not believe the high-number girls' immediate candy choice was necessarily indicative of any generalized lack of impulse control, nor any generalized distrust of others, nor even necessarily of any lack of ability to postpone gratification in most situations.

Our high-number children were active, and gave no indication of any generalized inhibition of affective expressiveness. Yet they were the most competent at tasks which presumably require "delay of motor discharge," according to the theory of the relationship between ego development and thought. Our finding would contradict any assumption that children would have to become quiet, or generally inhibited, in order to do abstract thinking. Yet we still believe it is true that general hyperactivity (of the sort that one sees in exaggerated degree in certain brain damage or extreme maternal deprivation cases) and restless movement does interfere with thinking. Perhaps the essential distinction lies in the difference between organized activity on the one hand and either random activity or generalized inhibition of movement on the other. Our high-number boys appeared to be able to inhibit premature motor discharge while thinking, but they could also get angry fairly easily and, we infer, participated frequently in active sports; this suggests the possibility that they discharged tension motorically and affectively at appropriate times and places and thus left themselves freer of tension during periods when they had to concentrate. It is evident that the relationship between motor inhibition or motor activity and such intellectual functions as the focusing of attention needs to be further explored in research.

To sum up what we have been saying, our data seem to provide some real evidence of the interconnectedness of personality development and the development of cognitive abilities. We have suggested that these relationships may best be conceptualized in the framework of a description of "ego-functions" and of the conditions which affect their development. Important among such conditions would be the kind of socialization which the child has experienced. Socialization practices and the concomitant interactions of parent and child may affect the amount of tension to which the child is subjected, the degree to which symbolic labels have become attached to direct perceptual experiences, the extent to which postponement of immediate gratification has "paid off," the amount of opportunity for object manipulation, and many other conditions which in turn determine the rate at which various ego functions will develop. And these ego functions will in turn mediate the acquisition of various cognitive skills. Our data do not permit us anything like a comprehensive statement of the nature of the relationships between socialization and interpersonal experiences and the development of cognitive abilities. They do suggest, however, that further more systematic studies in this area and from this point of view will be well worthwhile.

CHAPTER IX. SUMMARY

This study is primarily an assessment of a number of aspects of personality and personality-linked cognitive dispositions which we predicted were associated with the differential development of intellectual abilities. We defined "differential abilities" specifically as marked discrepancies, for any given child, among his scores on measures of three of the Primary Mental Abilities as defined by Thurstone. We selected a sample of 126 such children (70 boys and 56 girls) from the total fifth grade population of two neighboring school systems. The selection instrument was the Thurstone PMA test, supplemented by scores on achievement and aptitude tests available in the school records. We were interested in discrepancies among three types of ability: verbal, spatial, and numerical. We chose the following six groups:

High-verbal low-space
High-space low-verbal
High-verbal low-number
High-number low-verbal
High-space low-number
High-number low-space

Scores on the third ability were in each group intermediate between those on the other two. In order for a child to be included in any of the groups a discrepancy of at least 1.5 standard score units between his "high" and his "low" abilities was required. (Standard scores were computed on the total population of 1214 children tested.) In order to control for differences in general intelligence, the six groups were equated with respect to mean total score on the PMA. Where this proved not entirely feasible, the contribution of differences in total PMA was partialed out before comparing our groups on any of our other measures.

Our hypotheses concerned two broad classes of variables which we expected to differentiate among our differential ability groups. We, thus, included in our assessment both measures of interpersonal characteristics and measures of aspects of perceptual and cognitive functioning which we thought of as mediating between interpersonal experiences and the development of patterns of intellectual skills. The interpersonal characteristics (or personality traits) measured included aspects of aggression, dependency, self-sufficiency or mastery, sociability and popularity, self-esteem, and the acceptance and adoption of sex role. Most of these variables were measured in two ways, by means of specially devised or adapted self-report questionnaires and by means of classmates' reports on the Peer Nominations Inventory. In addition, a related study was carried out with the mothers of part of our sample, investigating child rearing practices and aspects of parent-child interaction. This study used both interviews and direct observation of mother-child interaction in a situation in which the child was required to carry out intellectual tasks.

Among our measures of perceptual functioning, the ones most directly related to interpersonal relations were two which were designed to reveal differences in sensitivity to interpersonal cues. We used for this purpose a test on selective recall of the interpersonal content of a movie and a "stick figures" test (designed as a measure of empathy) in which the subject matched adjectives to cartoon figures. We were interested also in the general variable of impulse control, and under this rubric included a test of capacity to postpone immediate gratification in favor of a more remote reward. We might also include here a number of procedures which we developed in order to test our subjects' ability to resist distraction while performing an intellectual (either verbal or numerical) task. Another group of tasks which we presented to our subjects was designed to yield measures of differences in the utilization of kinaesthetic cues, when other sensory data were disrupted. (Our obtained interrelationships, however, lead us to doubt whether we were, in fact, measuring such a factor.) These procedures included an oral verbal performance under conditions of delayed auditory feedback, a mirror drawing task in which the subject had to trace a figure with the visual image reversed, and a test of the ability to carry out maneuvers while blindfolded. And finally we included two tasks similar to ones which have been used in a number of studies of "cognitive style:" a version of the Gottschaldt embedded figures test and a task which involved the reproduction of tachistoscopically presented stimuli (a procedure derived from studies of "tolerance of ambiguity").

A related study carried out with our sample explored the question of the degree of correspondence between patterns of "convergent" intellectual abilities, as defined by our selection procedure, and the ability to carry out "divergent" or creative tasks involving the corresponding three kinds of material. This study investigated, for example, whether high-verbal children in our sample were relatively better than the other children at divergent verbal tasks and whether they were better at divergent verbal tasks than divergent numerical or spatial ones. Two other studies carried out in our laboratory as part of this general project (reported in Appendices III and IV) did not use the same sample of subjects. One of these was a study of Stanford freshmen and explored the relationships of discrepancies between verbal and numerical ability (as measured by the Scholastic Aptitude Test) to a number of items of personal data indicative of relationships with parents. The other explored further some of our findings on susceptibility to distraction. Using as subjects a new sample of fourth grade children, the investigator varied the nature of the distracting stimulus (interpersonal and nurturant in content versus impersonal) and tested half of the subjects after a period of presumably anxiety-provoking social isolation. The hypothesis, which was confirmed, was that social isolation would increase the relative effectiveness of the nurturant distractor in disrupting the subjects' performance. We have included these additional studies in this report since their findings seem to confirm and clarify those obtained with our original sample.

Our results can best be summarized by reviewing the characteristics which we found to be associated significantly with each of our three main patterns of differential ability. *High-verbal* children tend to be dependent when observed in interaction with their mothers (often ask for help) and indicate that they expect to receive help from their parents when they ask for it, even though they may not really need it. In addition, high-verbal girls are unlikely to derogate dependency in others. High-verbal boys are reported by their peers as quite high in dependency, but high-verbal girls are not; in fact, their peers tend not to see them as dependent. High-verbal children of both sexes are low in self-reported dependency. The mothers of these high-verbal children tend to be intrusive, giving help and direction even when it is not asked, and expecting high levels of achievement and conformity from their children. These findings suggest that the high-verbal children have been "trained" to a continued high level of dependency on their parents. That this dependency is not without conflict for them is suggested by their tendency to deny it. In fact, we have been led to conclude that the high-verbal children chronically experience a fairly high level of tension. The tension generated by their excessive dependency on adults is probably less disruptive for the girls in this group than for the boys. The latter report many hostile feelings, whereas the high-verbal girls show more positive characteristics. They are creative and they obtain low scores on measures of masculinity (i.e., sex-inappropriate behavior). They are also able to delay gratification, though this finding may be interpreted as another aspect of their dependency on adults. High-verbal children of both sexes are relatively quick to give judgments fo "sure" about ambiguous stimuli (although their judgments are in general no more likely to be correct), and thus may be seen as relatively intolerant of uncertainty. They are also much more likely to be disrupted by distracting conditions than our other groups. These findings, taken in conjunction with the data on the Stanford freshmen, in which it was found that high-verbal SAT scores (relative to math scores) were related to certain tension-producing intra-familial conditions, reinforce our interpretation of the association between a discrepancy in the direction of high verbal ability and a relatively high level of tension, probably related to continued dependency on adults. The finding of the increased susceptibility to a nurturant interpersonal distractor following social isolation has already been cited.

High-number children, in contrast, report that they would ask for help from parents when sick, alone, or afraid, but anticipate that parents would respond negatively if asked for help unnecessarily. The implication is that they have developed a considerable degree of self-sufficiency although maintaining a trusting relationship with adults. (One apparently contradictory finding is the tendency for high-number girls not to postpone gratification; alternative interpretations of this finding were discussed.) This conclusion is supported by the data on the mothers of the high-number children, who tend to allow them to work out problems for themselves, and also by the data on the college students. Among the freshmen, those characterized by relatively higher numerical performance reported less disturbed relationships with their parents. The high-number children are characterized by generally favorable peer relationships. They are popular with their classmates and have a high level of interaction with them. The girls particularly are seen as competent by their peers. The high-number children are also characterized by acceptance of their appropriate sex roles. There are, of course, some sex differences in the interpersonal characteristics which accompany this pattern of socially appropriate and acceptable behavior in the high-number children. The girls are particularly low in self-reported aggression, while the boys are seen as normally aggressive by their peers. They are also masculine and generally creative. In contrast to the high-verbal children, this group tends to reserve judgment about ambiguous figures and is relatively resistant to the effects of distraction. The high-number girls also tend not to be disrupted by delayed auditory feedback. The general impression is that the high-number children are the most mature and least subject to stress of our differential abilities groups.

The high-space children are, as one might expect, relatively superior at tasks which require spatial ability, such as the Gottschaldt figures. Their social behavior, however, seems relatively immature and unsuccessful. They are seen as relatively withdrawn by their peers and are low in sex role acceptance. Again, there are sex differences in the pattern of interpersonal characteristics found for the low-space children accompanying their sex-inappropriate orientation. High-space boys, as well as being low in masculinity, are low in mastery (as seen by their peers) and unaggressive. High-space girls, on the other hand, are masculine, aggressive, and report relatively little concern about aggressive impulses. They admit that they are likely to seek help when they encounter difficulty in problem-solving, but at the same time derogate dependency in others. They thus seem to displace onto others any anxiety they may feel about dependency. The best interpretation of these findings would seem to be that the high-space children are relatively immature, and there are some indications that this is related to a somewhat neglectful-permissive pattern of child rearing practiced by their mothers. At the same time, they have been allowed relative freedom for exploration of the environment and object manipulation, and this may well have contributed to the development of their spatial skills. The data do not, however, substantiate the hypothesis that they are more able to utilize kinaesthetic cues.

These findings only partially supported our original predictions. We have thus been led to a reformulation of our theoretical assumptions about the relationship between the aspects of personality and socialization experiences we studied and the development of differing patterns of intellectual abilities. We have proposed an analysis of the three areas of ability which differentiated our groups in terms of the various "ego functions" involved in their performance. We have then suggested some relationships between these functions and such general aspects of ego-maturation as the development of impulse control and intervening symbolic processes. It is our hope that this conceptualization will encompass our findings and point the way to further empirical clarification of the common antecedents and mediating processes which underlie the connections between personality and intellectual functioning.

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Appendix I. Measuring Instruments

Appendix I-a. Dependency scales

Here are some stories about things that might happen to a boy your age. Put an X beside the answer that tells what you would do, or how you would feel, if this happened to you.

If you had a cold and stayed home from school, would you like to have your breakfast in bed?

___Yes, it's nice to be waited on a little when you don't feel well.

___No, I like to be up and dressed even when I don't feel well.

A father comes home and trips over a boy's skates that he has left in the front walk. The boy should;

___Stay out of his father's way until he cools off.

___Run out to his father and apologize.

On a rainy day, what would you prefer?

___Call a friend to come and play with you.

___Play by yourself.

If you found a small child who was lost, which would you do?

___Try to find out where he lived and take him home.

___Tell the nearest grown-up that he was lost.

A boy's father is watching sports on TV on Saturday afternoon. The boy asks his father to come out and play ball with him. What would the father say?

___Oh, all right. Sure.

___I want to see the rest of this game. Can't you get some of your friends to play with you?

When you scrape your knee while playing, would you rather:

___Forget about it until you're through playing.

___Have it bandaged and taken care of right away.

You have moved into a new town and are going to a new school. When you go to the school you can't find the room you are supposed to be in. What do you do?

___Find a teacher and ask her where to go.

___Keep on looking on your own.

A mother and father are just leaving for the evening when their little boy says he can't find one of his toys that he wants to play with. What would the mother or father say?

___"We're just leaving. You'd better look some more yourself."

___"I'll help you look for it."

It is your first day at a summer camp and you have been given some free time. Which would you rather do?

___Write a letter home.

___Take a look around the camp.

A mother is talking on the telephone when a little boy runs in the door from school, calling: "I'm hungry, may I have something to eat?" What would the mother say?

___"I'll be right there."

___"Shhh---can't you see I'm busy?"

You have finished a job you were doing around the house after school It's 4:30. Would you:

___Play alone or watch T.V.?

___Go and find some friends to play with.

Your friend seems to be annoyed at you but you don't know why. What would you do?

___Do nothing, it will blow over.

___Ask him what you did and apologize.

___Try and be especially nice for a few days.

When you feel sad, would you rather:

___Be alone, or

___Be with some member of your family.

A public swimming pool has just been put in near your house. You don't know how to swim yet, but you want to go to the pool. What do you do?

___Ask your mother or father to give you some lessons.

___Go to the pool and start to teach yourself.

A boy is supposed to put all his school things in one place so he can find them in the morning, but he forgets. He's in a hurry to go to school, and he asks his mother to help him find a book he's supposed to take with him. She is in the middle of cooking breakfast. what would she say?

___"I'm busy right now -- you're supposed to put your school things where you can find them."

___"All right, let's see, where did you have it last?"

You have gone to a movie by yourself and just as you are taking your seat you see some boys you know on the other side of the theatre, would you:

___Go over and sit with them.

___Stay where you are.

Your mother comes home and finds that you and some other kids have been playing in the front yard and they have left some of their toys lying around. She is annoyed at the mess and wants you to pick it up. What do you do?

___Say you're sorry and start to pick up the toys.

___Tell her the other kids left them there.

You have cut across a lot where there is a dangerous and ugly dog on a chain. Suddenly the chain breaks and the dog runs after you, barking and baring his teeth. Would you:

___Try to keep him away with a stick.

___Run into the nearest house, even though you don't know the people who live there, and ask them to protect you.

If you were lost at night and far from home, which would you rather have with you:

___a flashlight.

___an older boy.

A boy's father is watching his favorite T.V. program when the boy asks him about a model airplane he's trying to put together. What does the father say?

___"I really want to watch this program. Try to do it yourself."

___"O.K., let's see what we can do with it."

You accidentally bumped into a friend of yours, and he thought you did it on purpose. You said you were sorry once, but he was still mad. What would you do?

___Say nothing and wait for him to forget about it.

___Tell him, again, you're sorry.

When you have to memorize things for school, would you rather:

___Have your parents listen to you recite them.

___Go in a room by yourself and repeat them till they are learned.

A boy is putting together a puzzle and is having trouble with it. He asks help from his father, who is outside mowing the lawn. What would the father say?

___"I'll be right in and help you."

___"If you just tried harder you could do things by yourself."

You are sent to the store to buy groceries and on the way your bicycle has a flat tire. Would you:

___Go to a garage and try to fix it yourself.

___Go to a garage and ask someone to help you fix it.

___Return home and ask your mother to take you.

A boy's father is resting on the couch. The boy asks him to help find a toy the boy has lost. What do you think the father would say?

___"O.K. Let's see if we can find it."

___"Don't bother me now. Why don't you try to find it yourself?"

You are working on some homework and one particular problem is giving you some trouble. Would you:

___Ask your parents if they could help.

___Work on the problem more yourself.

A boy wakes up in the middle of the night. He is frightened and runs into his mother's room. What would she say?

___"Don't be silly, go back to your room."

___"Let's go in together and make sure there's nothing there."

In the middle of the night, you wake up and feel sick, but don't know what is wrong. Do you:

___Wait and see if it goes away.

___Call for your parents right away.

When you get a new game which would you rather do?

___Find somebody who knows how to play it and get them to teach you.

___Figure out by yourself how to play it.

A boy is playing in the kitchen near his mother while she is fixing dinner. He accidentally bumps into her while she is working. He says he's sorry. What would she say?

___"That's all right, dear."

___"Please go somewhere else. You're in my way."

Something has happened to hurt your feelings and it wasn't your fault. Would you tell your mother about it so she could help cheer you up, or would you rather keep it to yourself?

___Tell your mother.

___Keep it to yourself.

A boy you know has been bothering you all day, giving you a push every so often. You have told him to cut it out. When you are taking a drink at the fountain, someone shoves you, and you turn around fast and hit him. It turns out to be your best friend. You try to explain, but he won't listen. What would you do?

___Wait for him after school, and try to explain again on the way home.

___Ignore him for a while till he cools off.

A boy's mother is just leaving the house to do some shopping. The boy is supposed to work on his homework. He says: "I wish you'd stay home with me -- I don't want to stay alone." What would his mother say?

___"I have to go -- it won't hurt you to stay by yourself for a little while.

___"O.K. -- I'll stay till you finish your homework, and then you can come with me."

1. Do you often feel sort of guilty without knowing why?

   ___Yes

   ___No

2. Most of the time do you think you are a pretty good person?

   ___Yes

   ___No

3. Do you usually feel you are about as good as most of your friends?

   ___Yes

   ___No

4. Are you worried or unhappy for quite a while after being caught doing some small thing that you shouldn't do?

   ___Yes

   ___No

5. Do you consider yourself a happy person?

   ___Yes

   ___No

6. Do you sometimes feel that you are pretty much of a fake?

   ___Yes

   ___No

7. Do you feel that you are living up to your own ideals?

   ___Yes

   ___No

8. Would your parents respect you if they knew every single thing you thought about for a whole day?

   ___Yes

   ___No

9. Do you ever have daydreams which make you ashamed of yourself?

___Yes

___No

10. Do you sometimes feel that you are not as thoughtful of other people as you should be?

___Yes

___No

11. Do you feel that you have strong enough will power to satisfy you?

___Yes

___No

12. Do you ever worry about yourself and wonder what's to become of you?

___Yes

___No

13. Can you stand being criticized without being hurt?

___Yes

___No

If you and a friend of yours have had a quarrel, who usually makes the first move to patch it up?

___My friend does

___I do

Suppose a boy in your class is sitting with his foot sticking out in the aisle. You trip over it. Would you apologize?

___No, because it was his own fault

___Yes, even if it was partly his fault

You want to go someplace with a group of kids, and you are not sure whether they are going to invite you. What would you do?

___be very nice to them

___ask them if you can go with them

___do nothing; just wait to see if they ask you

Suppose you have had a quarrel or fight with one of your friends. You are sure it was your friend's fault, not yours. What would you do?

___Wait for your friend to say he (she) is sorry

___Say you're sorry even if it wasn't your fault

If you and a friend of yours are mad at each other over something that happened, how much does the situation bother you?

___It bothers me a lot; I like to do something right away to make us friends again.

___It bothers me quite a bit, but not an awful lot; I can wait a little while before I try to patch it up.

___It doesn't bother me much; I know it will blow over and I don't feel I have to do anything about it.

You accidentally take your friend's book, thinking it is yours. Your friend sees you using it and gets mad. What do you do?

___Say you're sorry -- you thought it was yours

___Give it back and say nothing

You were supposed to meet your friend at a certain time. You were late and your friend had already left. What would you do? .

___Wait and see what he (she) says when you meet again

___Call up on the phone and explain

Appendix I-b.
Dependency and aggression items

Here are some statements. In front of each one, there are five little boxes. Read each statement carefully, and then put an X in one of the 5 boxes to show how you feel about the statement. If you agree strongly, put your X in the left-hand box. If you disagree strongly, put your X in the right-hand box. If you are not sure, mark the middle box. The words at the top of the boxes show what each box means.

Strongly agree	Agree	Not sure	Disagree	Strongly disagree		
☐	☐	☐	☐	☐	1.	When I go to a store that has many different kinds of ice cream, I would rather eat my favorite kind than try a new flavor.
☐	☐	☐	☐	☐	2.	When I'm workingoon something, I like to have a friend working with me.
☐	☐	☐	☐	☐	3.	I usually don't show it when I get angry, but it leaves me shaking inside afterward.
☐	☐	☐	☐	☐	4.	I like to watch a real man-sized slugging match in a movie or on TV.
☐	☐	☐	☐	☐	5.	Most of my troubles have been started by other people.
☐	☐	☐	☐	☐	6.	It makes me uncomfortable to see two of my friends fighting.
☐	☐	☐	☐	☐	7.	If someone gets hurt in an auto accident, I usually try to get a good view of what happened.
☐	☐	☐	☐	☐	8.	I would rather do something too hard than too easy.
☐	☐	☐	☐	☐	9.	When you work with someone else, they usually get in the way.
☐	☐	☐	☐	☐	10.	When I'm going somewhere new, I like my mother to go with me until I know my way around.
☐	☐	☐	☐	☐	11.	I like to have my mother fix new things for dinner sometimes, instead of always making my favorite foods.

Strongly agree	Agree	Not sure	Disagree	Strongly Disagree	
☐	☐	☐	☐	☐	12. You have to stand up for your rights -- even to the extent of fighting -- if you want to get along in the world.
☐	☐	☐	☐	☐	13. If I see a child my age waiting to cross the street until his mother can cross with him, I think, "What a baby!"
☐	☐	☐	☐	☐	14. When a person has broken an important rule, he should definitely be punished for it.
☐	☐	☐	☐	☐	15. I'm happiest when I'm alone.
☐	☐	☐	☐	☐	16. I don't think there is anybody who really is trying to do me harm.
☐	☐	☐	☐	☐	17. I get nervous when a big crowd of people are coming toward me.
☐	☐	☐	☐	☐	18. It doesn't bother me when my mother holds my hand.
☐	☐	☐	☐	☐	19. Laws against fighting ought to be more strictly enforced.
☐	☐	☐	☐	☐	20. If I get a present I think would be interesting to the class, I like to bring it to school to show them.
☐	☐	☐	☐	☐	21. If an older boy is mean to a younger one, the younger one has a perfect right to get even with him in any way he can, even in some secret and sneaky way.
☐	☐	☐	☐	☐	22. I don't like to go exploring in caves.
☐	☐	☐	☐	☐	23. It is all right for a teacher to criticize some in front of the class if that person has broken a rule.
☐	☐	☐	☐	☐	24. Being a cry baby is one of the worst things a little child can be.
☐	☐	☐	☐	☐	25. It makes me nervous to hear a gang of boys gett argumentative even when I'm not involved.
☐	☐	☐	☐	☐	26. Big dogs are likely to be dangerous.
☐	☐	☐	☐	☐	27. When I get angry, I usually feel bad afterward.

Strongly Agree	Agree	Not sure	Disagree	Strongly Disagree	
☐	☐	☐	☐	☐	28. A lot of adults seem to have it in for kids, and always are causing them trouble.
☐	☐	☐	☐	☐	29. Sometimes I have dreams in which somebody hurts me.
☐	☐	☐	☐	☐	30. I'd rather get a regular allowance than earn my own money.
☐	☐	☐	☐	☐	31. Sometimes an actual fight is the only way to settle an argument.
☐	☐	☐	☐	☐	32. At school, teachers should never permit any pushing or shoving among the children because someone might get hurt.
☐	☐	☐	☐	☐	33. I hate to go on and on trying to finish something when it's too hard.
☐	☐	☐	☐	☐	34. When someone does not pay attention to me, or just seems to look right through me, it is usually because he is secretly mad at me.
☐	☐	☐	☐	☐	35. Sometimes I feel that I have about as many enemies as I have friends.
☐	☐	☐	☐	☐	36. When I get too angry, I'm liable to get in trouble.
☐	☐	☐	☐	☐	37. When I'm climbing a tree, I like to go as high as I possibly can, even if the top branches are not very strong.
☐	☐	☐	☐	☐	38. I get annoyed with myself if I have to ask for help from grownups.
☐	☐	☐	☐	☐	39. I hate to hear people at a baseball game yelling "Kill the umpire!"
☐	☐	☐	☐	☐	40. I have to be careful what I say to people, because they get mad so easily.
☐	☐	☐	☐	☐	41. It is perfectly natural for boys to want to fight sometimes.
☐	☐	☐	☐	☐	42. It makes me nervous when another person my age tries to be too friendly with me.
☐	☐	☐	☐	☐	43. I hate to get up in front of the class because I don't like to have everyone looking at me.

Strongly Agree	Agree	Not sure	Disagree	Strongly Disagree		
☐	☐	☐	☐	☐	44.	There is too much fighting and arguing shown on TV.
☐	☐	☐	☐	☐	45.	My friends get mad at me more often than I get mad at them.
☐	☐	☐	☐	☐	46.	I sometimes wish we didn't have to learn new things all the time in school.
☐	☐	☐	☐	☐	47.	I get mad at myself when I cry.
☐	☐	☐	☐	☐	48.	Everybody in school should have a chance to act in a play sometime.
☐	☐	☐	☐	☐	49.	I hate to be alone for a whole afternoon.
☐	☐	☐	☐	☐	50.	Football would be a better game if you could be sure nobody would get tough and mean.
☐	☐	☐	☐	☐	51.	Arguing nearly always leads to trouble in one way or another.
☐	☐	☐	☐	☐	52.	People seem to find fault with me more than I deserve.
☐	☐	☐	☐	☐	53.	It makes me uncomfortable to see someone in my class trying to get the teacher's attention all the time.
☐	☐	☐	☐	☐	54.	I like to take things apart and put them back together again.
☐	☐	☐	☐	☐	55.	I really enjoy going for a long walk or bike ride by myself.
☐	☐	☐	☐	☐	56.	Sometimes I feel that there are so many bad people in the world that even my own town is about as dangerous to live in as a real jungle.
☐	☐	☐	☐	☐	57.	I think it's all right for children my age to kiss their mothers goodbye when they go to school.
☐	☐	☐	☐	☐	58.	It is all right to hurt someone as a punishment for doing wrong, but that is absolutely the only time one person should ever hurt another.
☐	☐	☐	☐	☐	59.	If I do a good paper or picture at school, I like to bring it home to show to my family.

Strongly Agree	Agree	Not sure	Disagree	Strongly Disagree	
☐	☐	☐	☐	☐	60. Hitting somebody smaller than you is absolutely never excusable.
☐	☐	☐	☐	☐	61. I really enjoy spending an afternoon by myself once in a while.
☐	☐	☐	☐	☐	62. Every boy ought to be taught how to box.
☐	☐	☐	☐	☐	63. Sometimes when I have been out alone at night, I have had the feeling that somebody was following me, even though I could never prove it.
☐	☐	☐	☐	☐	64. I don't see anything especially wrong about a fight between two gangs of teen-agers; it's their business, and adults should keep out of it.
☐	☐	☐	☐	☐	65. I like to see children showing affection to their parents.
☐	☐	☐	☐	☐	66. If a fifth grader starts a fight, he should be punished in some way, no matter why he started it.
☐	☐	☐	☐	☐	67. I like to do things in front of an audience.
☐	☐	☐	☐	☐	68. Teachers should be very careful never to let a class discussion get too heated or too personal.
☐	☐	☐	☐	☐	69. I am happiest when I am with a group of friends
☐	☐	☐	☐	☐	70. Every club should have a set of definite rules for the members, and someone should be chosen to enforce the rules.
☐	☐	☐	☐	☐	71. It upsets me to think that some thoughtless word or crack of mine might hurt someone's feelings.
☐	☐	☐	☐	☐	72. When I'm working in my workbook, I would rather work ahead on new problems than work on problems we have already discussed in class.
☐	☐	☐	☐	☐	73. There is a good chance that radiation from atomic bombs will kill off the human race.
☐	☐	☐	☐	☐	74. A good cleanly fought football game is about the best sport there is.

Appendix 1-c.
Peer Nominations Inventory
(sample page

SCHOOL:________________
GRADE:________________
TEACHER:________________
DATE:________________
NAME:________________

(Form B)

	TIM WELK	JIM FISK	DAN SNOW	RAY PARK	ABE HOWE	TAD ROSE	KEN LORD	ED COOK	RON PAGE	JOE MARX	SAM ROSS	DON MUDD	ART BLUM	AL TODD	ROB LADD
1. He's a good runner.															
2. He's pretty short.															
3. He's always losing things.															
4. He makes fun of people.															
5. He always does what the teacher says.															
6. He has a quick temper.															
7. He's good at getting things done.															

APPENDIX I-d

STICK FIGURES - NORMATIVE DATA

Directions: A number of stick figures of people in various positions will be shown to you. Each figure will be numbered and there will be a corresponding number on this paper, followed by three words. As the figures are shown to you, place an X after the one word of the three which best describes the way that figure looks to you.

Items		% boys N=150	% girls N=153	Items		% boys	% girls
11.	thinking	70	71	20.	nervous	8	14
	worried	21	19		relaxed	73	72
	resting	9	10		angry	19	14
12.	peeking	15	5	21.	annoyed	56	63
	awkward	23	26		shy	22	21
	curious	63	69		sad	22	16
13.	asleep	62	64	22.	awkward	23	16
	sad	11	8		polite	23	20
	afraid	27	28		watching	54	63
14.	tired	29	40	23.	happy	10	8
	thinking	56	48		basketball player	21	9
	patient	15	12		dancer	69	84
15.	sleeping	8	9	24.	begging	18	18
	sad	7	3		welcoming	47	57
	very tired	85	88		giving	35	26
16.	curious	9	10	25.	sissy	10	5
	puzzled	88	84		cautious	5	4
	happy	3	5		modeling	85	91
17.	doubtful	41	27	26.	stuck up	8	10
	hopeless	41	49		athlete	7	6
	wild	19	24		soldier	85	84
18.	puzzled	46	44	27.	jumpy	19	11
	doubtful	38	40		scared	43	40
	helpless	16	16		disgusted	39	49
19.	disgusted	15	12	28.	bored	31	31
	tempted	10	9		relaxing	65	63
	sending away	75	79		thinking	4	6

Items		% boys	% girls
29.	playing with child	7	4
	crawling	38	32
	looking for something	55	64
30.	reading	7	14
	watching	73	63
	thinking	19	23
31.	waiting	22	23
	curious	11	9
	relaxed	67	69
32.	stiff	9	10
	resting	27	35
	paying attention	64	55
33.	dancing	27	28
	very happy	63	58
	playing	10	14
34.	threatening	27	28
	athlete	7	4
	very angry	67	68
35.	afraid	18	19
	happy	7	7
	excited	74	74
36.	directing	43	53
	preaching	20	20
	dancing	36	27
37.	embarrassed	36	32
	worried	28	29
	angry	36	38
38.	suspicious	54	45
	athlete	18	14
	afraid	28	41
39.	shy	63	69
	ashamed	33	26
	sad	3	5
40.	baseball umpire	65	61
	waiting	8	7
	stubborn	28	31

Items		% boys	% girls
41.	angry	58	63
	having fun	28	27
	excited	14	10
42.	falling	41	44
	very happy	23	18
	fit of anger	37	37
43.	surprised	35	32
	happy	5	4
	watching	60	64
44.	sleeping	3	1
	thinking	7	7
	stretching	89	93
45.	stubborn	41	38
	surprised	5	4
	stuck up	55	58
46.	determined	49	48
	angry	20	19
	doubtful	31	19
47.	sad	6	3
	sneaking	68	70
	tired	25	27
48.	sissy	21	20
	stupid	30	30
	saying goodby	49	50
49.	afraid	1	00
	falling	32	33
	balancing	67	67
50.	tired	36	29
	sad	25	33
	thinking	39	38
51.	gloomy	37	49
	puzzled	51	39
	very tired	12	12
52.	happy	2	3
	resting	16	15
	waiting	82	82
53.	angry	3	1
	undecided	81	85
	surprised	17	14

Appendix I-e.
Sex typing and role adoption forms

1. Below is a list of things children do. Put a B before each one that you think boys can usually do better. Put a G before each one that you think girls can usually do better. Put an X by those in which you think boys and girls are about the same.

____running races

____doing arithmetic

____reading

____playing the piano

____making speeches

____working puzzles

____drawing

____making friends

____spelling

2. Below are a list of activities. Put a B before each one that you think boys are more interested in. Put a G before each one that you think girls are more interested in. Put an X by those in which you think boys and girls are equally interested.

____playing checkers

____reading fairy tales

____climbing trees

____riding a bicycle

____playing guessing games

____watching westerns on T.V.

____hiking and exploring

____drawing pictures

____talking on the telephone

____acting in a play

____tug of war

____going shopping

SECOND SECTION

Form A

Who do you think usually have the most interesting toys to play with, boys or girls?

____boys
____girls
____both have interestin
toys

Who do you think have the most interesting jobs?

____women
____men
____both have interestin
jobs

If you could be born again, which would you rather be, a boy or a girl?

____a boy
____a girl
____it wouldn't make
any difference

Which job do you think is more important?

____being a mother
____being a father
____they are equally
important

Who gets to do more of the things they want to do, boys or girls?

____boys
____girls
____they get to do what
they want to equally
often

Who do you think plays games that are the most fun, boys or girls?

____boys
____girls
____boy' and girls' game
are both fun

Appendix I-f.
Distraction Measures

Simultaneous Verbal Distraction (no distraction)

Form A

Name__________________________

Circle the word that means the opposite of the word on the left.

1. wet	a. bright	b. dry	c. tired	d. angry
2. cooked	a. raw	b. almost	c. soon	d. beside
3. laugh	a. eat	b. worry	c. cry	d. sleep
4. easy	a. fine	b. hard	c. wild	d. true
5. health	a. safety	b. library	c. club	d. sickness
6. fancy	a. plain	b. tapped	c. jumped	d. looked
7. pull	a. catch	b. show	c. throw	d. push
8. never	a. nearly	b. just	c. always	d. still
9. tall	a. short	b. great	c. safe	d. steady
10. winter	a. year	b. month	c. snow	d. summer
11. heat	a. enjoy	b. like	c. cool	d. pity
12. wide	a. deep	b. narrow	c. pretty	d. gray
13. loose	a. next	b. with	c. tight	d. across
14. smooth	a. rough	b. terrible	c. fair	d. bare
15. close	a. wipe	b. open	c. name	d. wear
16. float	a. brother	b. mother	c. baby	d. sink
17. enter	a. speak	b. think	c. exit	d. wish
18. poor	a. sorry	b. rich	c. hungry	d. glad
19. born	a. died	b. began	c. hoped	d. sang
20. full	a. loose	b. raw	c. empty	d. alike

GO ON TO THE NEXT PAGE

Form A
Page 2

21. add	a. member	b. subtract	c. person	d. teacher
22. bought	a. cost	b. shopped	c. looked	d. sold
23. noisy	a. brave	b. quiet	c. able	d. wooden
24. asleep	a. awake	b. strange	c. false	d. alive
25. enjoy	a. dull	b. black	c. dislike	d. golden
26. evening	a. time	b. morning	c. rule	d. farm
27. best	a. finest	b. worst	c. nicest	d. smallest
28. question	a. sentence	b. election	c. officer	d. answer
29. waste	a. build	b. dig	c. save	d. burn
30. part	a. whole	b. patch	c. cut	d. thing
31. damage	a. torn	b. repair	c. neat	d. ironed
32. east	a. direction	b. west	c. far	d. inside
33. give	a. throw	b. hold	c. carry	d. take
34. cloudy	a. grateful	b. frightened	c. smart	d. clear
35. empty	a. afraid	b. tired	c. full	d. white
36. cool	a. warm	b. line	c. fresh	d. cold

Simultaneous verbal distraction

Form B

Name ______________________

Circle the word that means the opposite of the word on the left.

1. low	a. green	b. high	c. even	d. silent
2. large	a. small	b. broad	c. ripe	d. sweet
3. north	a. down	b. outside	c. around	d. south
4. over	a. round	b. blind	c. under	d. tall
5. young	a. bright	b. royal	c. old	d. middle
6. fat	a. tight	b. thin	c. neat	d. rug
7. finished	a. started	b. thought	c. ended	d. walked
8. win	a. buy	b. send	c. carry	d. lose
9. build	a. usual	b. destroy	c. general	d. unless
10. fix	a. mend	b. talk	c. break	d. put
11. old	a. frozen	b. giant	c. main	d. new
12. goodness	a. evil	b. wall	c. little	d. chair
13. wrong	a. plenty	b. right	c. public	d. grateful
14. freeze	a. melt	b. go	c. come	d. bring
15. spring	a. may	b. farm	c. autumn	d. flower
16. gentle	a. steady	b. ugly	c. rough	d. stiff
17. top	a. side	b. coat	c. shoe	d. bottom
18. well	a. poorly	b. yet	c. back	d. still
19. raise	a. hold	b. lower	c. sit	d. bend
20. hot	a. evil	b. melted	c. big	d. cold

GO ON TO THE NEXT PAGE

Form B
Page 2

21. slave	**a. dull**	**b. wooden**	**c. free**	**d. alive**
22. backward	**a. forward**	**b. natural**	**c. clean**	**d. wild**
23. multiply	**a. single**	**b. divide**	**c. central**	**d. weary**
24. black	**a. green**	**b. distant**	**c. huge**	**d. white**
25. hill	**a. valley**	**b. bird**	**c. animal**	**d. road**
26. head	**a. honest**	**b. red**	**c. foot**	**d. lake**
27. peace	**a. war**	**b. country**	**c. letter**	**d. page**
28. alike	**a. same**	**b. different**	**c. pure**	**d. please**
29. past	**a. anger**	**b. present**	**c. rule**	**d. line**
30. sunny	**a. prince**	**b. boy**	**c. cat**	**d. shady**
31. happy	**a. cruel**	**b. sale**	**c. sad**	**d. broken**
32. more	**a. fresh**	**b. damp**	**c. less**	**d. straight**
33. true	**a. false**	**b. brave**	**c. round**	**d. square**
34. moving	**a. clear**	**b. fresh**	**c. still**	**d. tired**
35. wise	**a. careful**	**b. funny**	**c. quiet**	**d. foolish**
36. rare	**a. favorite**	**b. common**	**c. sweet**	**d. different**

Successive verbal distraction

Subject to choose opposites of the stimulus words, from this list:

Baseline, slide 1

BUSY
SLAVE
PROUD
LEAVE

free, glow, matter, idle, follow, dust, quickly, ashamed, coat, think

Baseline, slide 2

REMEMBER
ABOVE
INSIDE
ABSENT

afraid, outside, flower, present, fit, broken, below, forget, still, sound

Baseline, slide 3

CHEAP
PASS
STAND
CROOKED

almost, costly, lie, corner, pour, seldom, fail, straight, dear, torn

Baseline, slide 4

CRUEL
CITY
CENTER
BEGINNING

end, welcome, march, chain, kind, edge, trick, country, general, depend

Baseline, slide 5

EARLY
SMILE
DAY
PAST

allow, frown, ended, ice, look, slow, night, test, late, fierce

Baseline, slide 6

FIRST
LOUD
SUNRISE
WORK

breath, kept, last, play, turn, sunset, broad, report, glass, soft

Distraction, slide 1

SMART
TOGETHER
LIGHT
WEAK

stupid, school, strong, usual, tiny, around, alone, dark, rather, animal

Distraction, slide 2

ENEMY
FAR
THICK
DIRTY

even, title, clean, fine, master,
friend, eat, thin, near, tapped

Distraction, slide 3

YES
CAREFUL
SHOUT
UGLY

trouble, whisper, pile, no, careless
green, match, pretty, secret, with

Distraction, slide 4

LOVE
ON
LEAVE
RUN

mean, off, decide, idea, choice,
hate, crawl, field, arrive, general

Distraction, slide 5

BACK
LEAST
INTERESTING
SOUR

front, welcome, sweet, power, dull,
country, most, baby, throw, amount

Distraction, slide 6

LEFT
BEFORE
TAME
DULL

wild, after, bend, finally, joy,
middle, leader, sharp, right, length

Simultaneous numerical distraction

Name____________________
School____________________
Form A

Add: 86 93 +21	**Add:** 87 30 +52	**Add:** 67 21 + 9	**Add:** 35 23 + 5	**Add:** 68 47 +29
462 384 + 75	283 42 +389	76 347 + 89	204 95 + 98	$4.76 .83 + .24
Subtract: 569 -238	**Subtract:** 382 -157	**Subtract:** 765 -239	**Subtract:** 700 -376	**Subtract:** $1.70 - .80
1275 - 836	4798 -2346	5000 -2467	8000 - 756	$30.00 -27.60
Multiply: 73 x84	**Multiply:** 89 x76	**Multiply:** $.83 x 95	**Multiply:** 75 x87	**Multiply:** 57 x65
Divide: 8/$\overline{480}$	**Divide:** 9/$\overline{7254}$	**Divide:** 4/$\overline{\$3.44}$	**Divide:** 7/$\overline{\$37.94}$	**Divide:** 6/$\overline{4674}$

Simultaneous numerical distraction

Name____________________
School___________________
Form B

Add:	**Add:**	**Add:**	**Add:**	**Add:**
42 86 +22	38 46 +75	44 18 + 6	27 84 + 9	$.95 .76 +.82
473 28 + 54	563 275 + 89	74 356 + 87	465 287 +963	458 794 + 28
Subtract:	**Subtract:**	**Subtract:**	**Subtract:**	**Subtract:**
432 -168	391 -123	867 -243	500 -218	$2.30 - .60
3716 - 421	7526 -2634	2000 -1643	9000 - 352	$42.00 -26.80
Multiply:	**Multiply:**	**Multiply:**	**Multiply:**	**Multiply:**
42 x56	74 x29	$.47 x68	51 x73	84 x17
Divide:	**Divide:**	**Divide:**	**Divide:**	**Divide:**
7/490	5/3045	8/$7.12	4/$29.40	6/3414

SUCCESSIVE DISTRACTION, NUMERICAL

Baseline, Slide No.		
1.	426	937, 426, 320, 246, 460, 428
2.	7253	1023, 3725, 7253, 2375, 7289, 4639
3.	1603	1603, 4065, 1647, 8795, 6103, 5426
4.	2470	4381, 2431, 2897, 2704, 3189, 2470
5.	65942	65237, 65942, 75987, 32456, 59624, 82974
6.	89723	52741, 79832, 61943, 89723, 89461, 74012
7.	14065	14238, 41065, 36852, 85641, 14065, 71943
8.	32548	32548, 10684, 59472, 27581, 32196, 35284
9.	635279	638451, 124578, 706583, 697253, 542960, 635279
10.	173652	237948, 173652, 328965, 731265, 276984, 174983
Distraction		
1.	831	104, 831, 469, 381, 271, 837
2.	6405	6473, 5046, 9832, 6405, 4279, 3586
3.	1257	2368, 7512, 1263, 4328, 1257, 8967
4.	4619	4619, 7528, 2104, 3617, 1946, 4685
5.	37298	95348, 32789, 37456, 48650, 27562, 37298
6.	96501	56901, 42367, 96501, 84502, 96473, 73286
7.	74682	46728, 74682, 60321, 82634, 74391, 94261
8.	27438	10623, 43865, 27438, 27169, 83427, 74568
9.	485792	791632, 847529, 483152, 485792, 134683, 274568
10.	850934	734089, 528417, 850934, 468253, 854762, 439508

APPENDIX II.

THE EFFECT OF CHILD REARING PRACTICES ON DEVELOPMENT OF DIFFERENTIAL COGNITIVE ABILITIES[1]

by

Elizabeth Bing

Individual differences in cognitive development have come to be considered the result of interactions between a child's life experiences and the set of genes with which he has been endowed. Relationships have been found between cognitive abilities, perceptual and cognitive style on one side and personality traits on the other side, and some investigators have made efforts to identify antecedent conditions in the home which would be responsible for differences in children's personality as well as cognitive development. Thus "democratic homes" (Baldwin, 1955, 1945), "maternal acceleration" (Moss & Kagan, 1958), and a "warm, positive family atmosphere" (Milner, 1951) have been reported to increase the rate of growth of children's intelligence, especially verbal ability. Results of investigations of the effect of institutionalization and prolonged hospitalization of infants, summarized by Dorothea McCarthy (1954, 584-585) uniformly indicate retardation in language development. On the other hand, there has been suggestive evidence that certain conditions favor disproportionately the development of verbal ability and possibly impede the development of non-verbal skills, like numerical and spatial ability. Suggested as antecedents for such differential development in favor of verbal ability were "growth restricting" child rearing practices (Witkin, 1959), such as parental over-limitation and excessive control, "maternal overprotection (Levy, 1943), "emphasis on verbal accomplishment" (Levinson, 1958), and a "demanding discipline with emphasis on academic achievement" (Kent & Davis, 1957). Similarly, over-anxious discipline (Kent & Davis, 1957), and tense parent-child relationships (Kagan & Moss, 1961) were postulated to be responsible for low non-verbal, especially spatial ability in children.

While the consistently found superiority of boys over girls in spatial ability may be considered innate (Bieri et al., 1958; Emmet, 1949; Herzberg & Lepkin, 1954; Hobson, 1947), there has been suggestive evidence that this may be the result of differences in roles assigned to males and females in our culture (Bieri, 1960; Gardner et al., 1959; Pettigrew, 1958; Wallach & Caron, 1959).

Most of these studies, while yielding intriguing leads, failed to measure children's verbal and non-verbal abilities with relatively "pure" tests. Also, these studies investigated primarily parents' present day child rearing behavior and did not attempt to investigate the very early mother-child relationships. Furthermore, the sole measure of parents' behavior used was the interview of the parent.

In the present study, specifically designed tests were used to measure children's verbal and non-verbal abilities, such as spatial and numerical, as well as their total I.Q. in order to identify groups of children with discrepant abilities. An effort was made to investigate not only present, but also early child rearing practices as far as they may be assumed to be antecedents to differential cognitive development in children. And finally, the mother's actual mode of interaction with the child was observed in a fairly structured situation.

From the theoretical considerations and available research findings, it was assumed that child rearing practices which stimulate, reward, and encourage verbal or non-verbal abilities should increase either one of these abilities, and that fostering dependency should favor verbal ability while at the same time depressing non-verbal ability, whereas fostering independence should have the opposite effect. While not consistent over all age groups, some studies indicate female superiority in verbal and male superiority in numerical ability (Kuckenberg, 1962). It was therefore thought worthwhile testing the hypothesis that emphasis on sex-typing should reinforce verbality as a sex-appropriate trait in girls and spatial and numerical ability in boys.

An interview and questionnaire were designed to obtain information on the variables which were assumed to be more strongly represented in high verbal or in high non-verbal groups and the following predictions were made:

A. Verbal ability should be associated with (positive association unless otherwise indicated)

1. Verbal stimulation and interest shown by mother.
   a) especially during early childhood: Amount of playtime mother had with infant, verbal stimulation of infant, mother's verbal responsiveness to child's questions, taking child on outings, amount of early reading to child, tutoring before school, interest shown in child's good speech habits, importance attached to early accomplishments.
   b) during school age years: Number of story books, use of encyclopedia and "word games" played by family.
2. Verbal freedom: Permissiveness for verbal aggression, punishment for verbal aggression (negative association) and for poor speech (negative association), participation in meal conversation, permissiveness to listen to, or participate in adult conversation, permissiveness for discussion of "adult" topics, democratic family discussion.
3. Emphasis on academic achievement: Rewarding good and criticizing poor academic achievement, level of schooling desired for child, amount of present tutoring.
4. Emphasis on sociability: Rewarding sociability, providing opportunity for sociability, teaching manners and discouraging sociability (negative association).
5. Emphasis on sex-typing and parent's own verbal interest. For girls: mother's emphasis on girl's femininity and sex-appropriate behavior, and father being stricter than mother as a sign of adherence to appropriate sex-role behavior in family's pattern of living; for both sexes, like-sex parent's time spent reading

B. Non-verbal ability should be associated with

1. Non-verbal stimulation and freedom of exploration

   a) Opportunity for object experimentation: Number of toys at pre-school age, extent to which tools, gadgets, and objects are available to child for experimentation.

   b) Freedom to explore the environment: Permissiveness for early exploration and object experimentation, lack of restrictions indoors and outdoors, and strictness of time schedules (negatively associated).

2. Emphasis on sex-typing and parent's own non-verbal interest: For boys, mother's emphasis on boy's masculinity and boy's sex-appropriate behavior; for both sexes, parent's time spent together with child in arts, crafts, hobbies, and do-it-yourself activities.

C. Verbal ability should be positively associated with mother's dependency-fostering behavior and non-verbal ability with behavior fostering independence.

1. Fostering Dependency: Encouragement and lack of punishment of emotional dependency, permissiveness for instrumental dependency, protectiveness, anxiety arousal in cautiousness training, continuity of mother-child relationship and of caretaking activity.

2. Fostering Independence: Earliness of age at which mother expects independence to be achieved in different areas, pressure for responsibilities, permissiveness to spend allowance freely, permissiveness for independence, pressure for independence.

Furthermore, an observation session was designed in which the child was asked to do verbal as well as performance tasks in the presence of the mother in order to elicit from the mother a variety of behaviors which would make it possible to test the following predictions:

1. High verbal group mothers should be more active verbally than the low verbal group mothers in all categories of help-giving behavior (focusing, encouragement, approval, prompting, and answering problem for child).
2. High verbal group mothers should use more "pressure for improvement."
3. High verbal group mothers should have more "positive" interaction with child, i.e., give help more often after a request from the child.
4. High non-verbal mothers should disapprove and withhold help more often when requested by the child.
5. High verbal group mothers should ask the observer more questions.
6. On the performance tasks, high verbal group mothers should give more physical help, and abstain less often from giving any help.
7. On performance tasks, high verbal group mothers should give physical help sooner.

Methods and Procedures

Subjects

The subjects of the sample consisted of 60 mothers who had children who were in the fifth grade and had discrepant cognitive abilities. The basic discrepancy that was of interest for the purpose of the study was the comparison of high verbal children with low verbal children of similar I.Q., the complementary non-verbal abilities being either spatial or numerical ability. This resulted in the establishment of the following groups: 16 high verbal boys, 16 low verbal boys, 12 high verbal girls, 16 low verbal girls. For one half of each of the group of 16 the contrasting high or low ability was space and for the other half number, and out of the 12 high verbal girls, eight were low in space and four were low in number. The subjects for the study of child rearing practices, then, constitute a sub-sample of the children who served as subjects in the larger "differential abilities" project described elsewhere in this report.

Omitted are all the children whose major contrast was between number and space ability, with an intermediate level of verbal ability.

Procedures for Measurement of Antecedent Variables

Questionnaire. The mother was asked to fill in a questionnaire which consisted of twenty groups of questions referring to factual material in relation to the mother's caretaking activity of the child, to the child's first verbal and non-verbal accomplishments, to kinds of toys, number of story books and to the mother's as well as her husband's interest in reading and manual activities. The mother was also asked to estimate age levels at which she thought the average child would have usually learned a variety of listed behaviors, some of these based on Winterbottom's scale (1953), such as feeding himself, keeping room tidy, shopping for own clothing, crossing busy street, etc.

On the basis of a previously constructed rating scale, a total of 16 dimensions representing possible antecedent variables was rated. Some of the scales could be objectively scored according to a specified point system; in cases where the answer could be given in numerical form, the number was regarded as the score, transformed into a standard score in accordance with the total frequency distribution; for other scales, five fairly specific levels were indicated ranging from a high level of five to a low level of one.

Three raters were used for the ratings. They did not know to which group the case belonged and assignments were made in such a way that each one of the three raters double rated at least ten cases with each of the other two raters.

Interview. The interviews with the mothers were semi-structured with open-ended questions similar to the type developed by Sears, Maccoby and Levin (1957), and by Bandura and Walters (1959). It was attempted to cover in the interviews the child's early history as well as the present with respect to the mother's behavior regarding her relationship with the child, verbal stimulation provided by her, fostering dependency or independence in the child, verbal freedom allowed, permission for object experimentation, emphasis on sociability, academic achievement and sex-typing, and restrictiveness. The interviews lasted from one to two hours, were tape-recorded and conducted by one graduate student in psychology and the author. Neither of the two interviewers knew to which group the mother belonged.[2]

Three graduate students in psychology and the author rated the interviews from the tape-recordings according to preconstructed rating scales comprising 41 dimensions. Most of these scales were five-point scales, specifying five different levels of behavior or attitudes. All 60 interviews were rated by various combinations of two of the four raters, and none of the raters knew to which group the case belonged.

Interaction situation. Either before or after the interview, the child was called in and the mother was asked to read some verbal problem questions to the child, and following the completion of this task, the child was requested by the observer to perform two non-verbal tasks.

While seemingly the child's performance was the focus of attention, the situation was devised to obtain first-hand observational data on the mother's mode of interaction with the child. The situation was so constructed that the mothers could demonstrate a great variability of behavior, from no intervention at all to a high degree of helping, pressuring or disapproving types of behavior.

For the verbal task, a comprehension type test was used. It contained five problem situations which were rather difficult for 10-year-old children to answer satisfactorily. The questions were also worded in such a way that several solutions were possible. Two of the questions required the child to give reasons to explain a fact; the reasons being manifold, it gave the mother an opportunity to prompt, encourage, or pressure the child to improve his answer (Example: Why should children not be out in the street alone at night?).

The first of the non-verbal tasks consisted of putting together a complicated jig-saw puzzle (commercially available, Crazy Quilt, Tryco, No. 114). The child had to fit the colored pieces together into a pattern following a model.

At the same time, the mother was provided with a model which showed the placement of all pieces more clearly than the child's model did, thus putting the mother in a position where she was able to help and could do so as much as she wanted to and in whatever way she chose. The other non-verbal task was the Healy Picture Completion Test, in which the child was requested to put the block with the best fitting picture detail in a large picture with recessed spaces for the blocks. While there is always one "best" solution, there are also other adequate solutions. This situation provided the mother again with the opportunity to assist or pressure the child for improvement of his solution. The two performance tasks gave the mother an opportunity for helping the child not only with verbal means, but also with a variety of physical ways of assisting, like actually moving pieces into place,or handing the appropriate piece to the child.

In order to have the interaction situations as comparable as possible, the following procedures were adhered to:

After mother and child are comfortably seated side by side at the table opposite to the observer, the following instructions were given: "Since (child's name) happens to be in this project, we know a little bit how he is learning at school, However, we know very little about how he and children in general are learning in the home. We have here a number of fairly hard tasks. Let's suppose these are problems that (child's name) has brought home and is supposed to solve. I would like you to have (child's name) do these tasks in whatever way you think would give him a chance to do his best. Here are some questions that I would like you to read to (child's name) and later on we have some puzzles to do. Now pretend that I am not here and go ahead as you would at home."

The observer handed to the mother the question sheet which contained five problem tasks. After mother and child had finished these tasks, the observer asked the child to do a puzzle with the help of a model; and the mother was given the more clearly marked model; both were told that the mother's copy made the solution of the problem easier. After completion of the puzzle or after 10 minutes, whichever was earlier, the Healy Picture Completion Test was presented with standardized instructions. After 10 minutes or after completion of this task, the observer commended the child for his efforts and ended the session. Whenever during the procedure the mother asked the observer any question about her participation in the situation, he said:

"You can enter into this as much or as little as you feel like." The whole procedure usually lasted about half an hour, and most children seemed to like the novelty of the situation. The mother's behavior with the child during the verbal and non-verbal tasks was analyzed according to pre-established categories which were thought to represent different degrees and manners of stimulating and helping the child with his tasks. The following nine categories could be distinguished for both verbal and performance tasks: Focusing, Approval, Encouragement, Prompting, Giving answers (instead of letting child answer), Pressure for improvement, Disapproval, Withholding help, and Helping after request from child. One category covering the number of questions the mother asked the experimenter was devised as yielding a possible measure of the mother's dependency needs, or at least her need for more structure. Three additional categories were established for the non-verbal tasks, dealing with the mother's physical help-giving behavior, such as the mother's own handling of puzzle pieces, showing of her own copy to child, and the time elapsed until the mother made her first help-giving response. This resulted in a total of 22 categories.

The scoring was done by the person who conducted the interview. For five cases of the sample the alternate interviewer was also present and scored the behavior independently so that the reliability of the scoring was established on the basis of these five sample cases in addition to five pre-testing cases which were double scored.

Reliabilities of Ratings

As a measure of the reliabilities of the ratings for the questionnaire and the interview, the percentage of cases with perfect agreement between two raters and the percentage of cases with one and with more than one point difference was computed for every scale. Perfect agreement of ratings ranged from 62 to 100 per cent of the cases for the questionnaire scales and from 48 to 88 per cent for the interview scales. Agreement within one point ranged from 89 to 100 per cent for questionnaire scales and from 87 to 100 per cent for the interview scales.

The percentage of cases showing perfect agreement between two scorers for the various categories of the interaction situation ranged from 50 to 100 and agreement within one point ranged from 80 to 100 per cent.

Correlational Analysis and Combination of Variables

From the questionnaire, the interview and the interaction situation, a total of 79 variables was obtained. In cases where variables were assumed to belong to the same complex of behavior, but to represent different aspects of it, the scores of these variables were combined, if the variables also actually showed a correlation of at least .26 which corresponds to the .05 level of significance for our sample of 60 cases. As a result of these combinations, the 16 questionnaire and 41 interview variables were reduced to a total of 34 variables and the 22 interaction categories or variables to a total of 15.

The differences between the means of all variables for the high verbal children as compared to the low verbal children, and for the high verbal boys and girls as compared to the low verbal boys and girls had to be tested for significance. This was done by the t technique for testing differences between independent means for small samples. For two variables showing extremely skewed distributions, the Chi-square method for testing the significance of the differences between the distributions for two contrast groups was used.

Results

Interview and Questionnaire

Out of the 34 single and combined variables of the interview and questionnaire, ten[3] were found to distinguish significantly between high and low verbal groups. (See Table 1.)

(Insert Table 1 about here)

Antecedents of Verbal Ability

1. Verbal stimulation and interest shown by mother. For the early childhood period, a conbination of measures relating to the child's early verbal stimulation (amount of playtime mother had with infant; verbal stimulation of infant; mother's responsiveness to child's early questions; taking young child on outings; early reading to child; tutoring before school; interest shown in child's good speech habits) differentiated on a highly significant level between high verbal and low verbal groups for boys and for sexes combined as predicted, the probability of significance being <.001 in favor of more verbal stimulation during infancy occurring with high verbal than with low verbal groups. While for girls, taken by themselves, the mean of this variable was higher for the high verbal than for the low verbal group, the difference was not large enough to be significant.

Using the number of memories that a mother was able to report on her baby's early verbal and non-verbal accomplishments as a measure of importance attached to these and as an indirect measure of attention given to the child, it was found that this variable, also, was significantly higher for high verbal groups, if boys and sexes combined were considered. However, the difference, while in the expected direction, didnnot reach significance for girls.

For the period after school age, the specific measures hypothesized to differentiate between HiV and LoV groups were (1) number of story books, and (2) use of encyclopedia and "word-games" played by family. Only with regard to story books, the hypothesis was confirmed for boys and sexes combined.

Table 1

Significance of Differences between Means of High Verbal and Low Verbal Groups for Boys (N = 32) and Girls (N = 28) and Sexes Combined (N = 60) on all Variables Distinguishing between these Groups

	BOYS			GIRLS			SEXES COMBINED		
	High Verbal	Low Verbal	$p^{1)}$	High Verbal	Low Verbal	$p^{1)}$	High Verbal	Low Verbal	$p^{1)}$
Interview and Questionnaire Variables									
Early verbal stimulation	44.06	34.37	<.001	38.92	33.56	n.s.	41.86	33.97	<.001
Memory for early accomplishments	19.12	14.37	>.05*	16.00	12.56	n.s.	17.78	13.47	.02*
Number of story books	36.25	23.94	>.05	37.00	24.19	n.s.	36.57	24.06	<.05
Punishment for poor speech	5.37	5.81	n.s.	4.66	6.06	<.05	5.07	5.93	n.s.
Participation in meal conversations	6.37	4.31	<.01	6.42	6.12	n.s.	6.39	5.22	<.05
Criticism for academic achievement	7.56	6.37	<.05	6.75	5.31	<.05	7.21	5.84	<.01
Permissiveness for object experimentation and lacks restrictions	17.56	22.19	<.05	18.50	15.87	n.s.	18.00	19.00	n.s.
Anxiety arousal in cautiousness training	4.87	3.87	>.05	4.33	3.81	n.s.	4.64	3.84	<.05
Father's reading time	12.00	15.62	n.s.	14.08	6.31	<.001	12.89	10.96	n.s.
Father's strictness	5.25	4.37	n.s.	6.08	4.56	n.s.	5.61	4.47	.05*
Situation Variables									
Helping on verbal and non-verbal tasks$^{2)}$	404.75	386.75	n.s.	438.00	388.06	<.01	419.00	387.41	<.01
Helping on non-verbal tasks$^{3)}$	157.75	142.69	<.05	166.33	143.94	<.01	161.43	143.31	<.01
Approval on non-verbal tasks	47.87	48.37	n.s.	56.16	47.87	<.05	51.43	48.12	n.s.
Focusing on verbal tasks	48.44	48.44	n.s.	55.00	49.25	<.01	51.25	48.84	n.s.
Pressure for improvement on non-verbal tasks	47.62	50.75	n.s.	54.83	47.19	<.05	50.50	47.81	n.s.
Pressure for improvement on verbal and non-verbal tasks	99.56	99.75	n.s.	105.17	96.12	<.05	101.96	97.94	n.s.
Help after request	3.00	3.25	n.s.	6.08	1.75	<.01	4.32	2.50	<.05
Child's bids for help	4.12	3.69	n.s.	6.83	2.25	<.01	5.29	2.97	<.05
Withholding help and disapproval	4.62	3.31	n.s.	4.42	1.94	<.05*	4.53	2.62	<.05*
Mother questions observer	2.18	1.56	n.s.	3.08	1.69	<.05	2.57	1.62	>.01

1)One-tailed test unless marked *.

2)Combination of 8 categories: focusing, prompting and encouragement, approval, giving answers on both verbal and on non-verbal tasks.

3)Combination of 3 categories: focusing, prompting and encouragement, and giving answers on non-verbal tasks.

Caution is needed in interpreting the higher number of story books in the HiV group as an antecedent to the child's high verbal ability. The possession of a greater number of books by age 10 may be a consequence of the child's high verbal interest and ability. It is interesting to note that Milner (1951) found a greater number of story books among her high verbal six-year olds, an age level at which being exposed to story books can be considered as an antecedent condition to a greater extent, since the child's reading ability has hardly developed.

2. Verbal freedom. Two of the seven scales assumed to measure different aspects of verbal freedom differentiated significantly between groups as predicted. Punishment for poor speech differentiated significantly in favor of LoV as compared to HiV girls and amount of meal conversation distinguished HiV from LoV groups significantly for boys and for sexes combined. None of the differences on the measures dealing with permissiveness or punishment for verbal aggression, permissiveness to listen and participate in adult conversation, and freedom for democratic discussion to discuss "adult" topics was significant.[4]

3. Emphasis on academic achievement. The hypothesis that verbal ability should be associated with emphasis on academic achievement was confirmed when criticism for poor academic achievement was taken as a separate measure, but not for a combination of this measure with rewarding academic achievement, level of schooling desired by parents, and amount of present tutoring. Criticism for poor academic achievement, taken by itself, discriminated significantly between HiV and LoV groups for boys, girls, and for sexes combined, the means of criticism of poor academic achievement being higher for all high verbal groups.

5. Sex-role differentiation and parent's own verbal interest. It was hypothesized that for girls, verbal ability should be positively associated with mother's emphasis on the girl's adopting a feminine role and sex-appropriate behavior, and with father's relative strictness, and that for both sexes it would be associated with like-sex parent's amount of time spent reading. The hypothesis

with respect to father's strictness was partly confirmed; significant results were obtained though not predicted for girls with respect to father's reading time. None of the other variables of this cluster distinguished significantly between groups.

While mothers of the high verbal group girls reported on the average that their husbands were stricter than themselves, this difference failed to reach significance. However, further analysis of the data indicated that for those of the HiV girls whose low ability was space, the difference was significant at the .05 level, the stricter father being associated with the HiV girl group.

One assumption had been that the mother's perception of the father as the "Master" would enhance the masculinity of the male role and implicitly the feminine role of the girl in the family and may reveal the importance that the mother attaches to appropriate sex-typing, and thereby strengthening girls' verbal ability. This was borne out with respect to the HiV-LoS girls and their contrast group.

The fact that father's reading time discriminated highly in favor of high verbal ability only for girls and not for boys was just as surprising as the fact that mother's reading time did not differentiate between any of the groups. The latter fact may be due to lower dispersion of scores on reading time for mothers. The assumption that with respect to verbal and non-verbal ability children would model themselves after the like-sex parent was not borne out. Many of the mothers' behavior patterns and attitudes that were investigated through the interview seemed to influence boys' cognitive development, but not girls'; on the other hand, out of the very few behavior patterns pertaining to fathers that were evaluated, two proved to be significantly associated with girls' cognitive development. This points to the possible importance of the influence of the opposite-sex parent on the child's cognitive development. Such an influence is hard to account for in terms of our present knowledge of personality development, but merits further investigation.

Antecedents of Non-verbal Ability

1. Non-verbal stimulation and freedom of exploration. It was hypothesized that non-verbal ability should be associated with opportunity and freedom for exploration and object experimentation at pre-school age, and at present. This hypothesis was confirmed with respect to boys for a combination of the measures of permissiveness for object experimentation at pre-school age, availability to child of tools, gadgets, and objects for experimentation at present and lack of restrictions indoors and outdoors. It was not confirmed for the measures of number of toys at pre-school age and strictness of time schedule.

While the number of toys that children have before school age did not seem to be a significant antecedent to non-verbal cognitive development, the freedom the children have in playing with these toys and in exploring their environment was the condition that discriminated significantly between HiV and LoV groups of boys, the greater freedom being associated with the low verbal boys who are high either in Space or Number.

2. Sex-role differentiation, and parent's own non-verbal interest. It was hypothesized that non-verbal ability should be positively associated for boys with mother's emphasis on the boy's adopting a masculine role and sex-appropriate behavior and for both sexes with parents' time spent with child in arts, crafts, hobbies and do-it-yourself activities. None of these hypotheses was confirmed.

Dependency-Independence

It was hypothesized that verbal ability was associated with mother's behavior fostering dependency and non-verbal ability with behavior fostering independence. Dependency-fostering behavior was measured by (1) encouragement of emotional dependency and lack of punishment for dependency; (2) permissiveness for instrumental dependency; (3) anxiety arousal in cautiousness training; (4) continuity of mother-child relationship, and of (5) caretaking activity.

One of these five measures, anxiety arousal in cautiousness training, differentiated between the high and low verbal group, greater anxiety arousal being associated with the HiV group for boys and sexes combined.

The assumption was thus borne out, at least for boys, that the mother who tried to impress the child more with the potential dangers of the environment would make the child more anxious, insecure and dependent, and thus less capable of dealing with cognitive tasks presumably requiring more independence, such as arithmetic and spatial relations.

Behavior fostering independence was measured by (1) earliness of age at which mothers expect the achievement of independence by child in different areas; (2) pressure for responsibilities; (3) permissiveness to spend allowance freely; and (4) a combined scale of permissiveness for independence, pressure for independence and a lack of protectiveness. None of these four measures distinguished between High verbal and Low verbal groups as predicted.[5]

The result that some of the variables, like pressure for responsibility, and pressure for independence, which were considered to belong to the cluster of variables fostering independence did not differentiate between the groups is probably due to the fact that there is no linear relationship between these variables and independence. An excess of pressure for mature behavior may lead to more manifestations of dependency. Similarly, permissiveness for dependency on the part of the parent does not necessarily show a linear relationship with dependency behavior in the child. It may also be useful in future studies to distinguish between "independence" in the sense of self-help and "Independence" in the sense of self-determination. Conditions which foster dependency or independence are varied, subtle and extremely difficult to measure through one standardized interview. It might very well be that the observational method proved to be more sensitive and apt to pick up differences between mothers with respect to the dependency-independence dimension.

Interaction Situation

Six of the seven hypotheses were essentially confirmed. One hypothesis was not only not confirmed, but the opposite of the stated hypothesis was confirmed. (See Table 1.)

1. The hypothesis that high verbal group mothers should be more active in all categories of help-giving behavior (focusing, encouragement, approval, prompting and answering problems for child) was confirmed, at least when these categories were combined. The differences were significant at the <.01 level for girls and for sexes combined. However, the differences were not significant for boys alone. When the help-giving behavior on the non-verbal tasks alone was considered, the differences in favor of the high-verbal mothers were highly significant for the same groups, in addition to a difference on the <.05 level for the boys. On the other hand, if one considers some of the help-giving activities on the verbal tasks alone, they did not yield significant differences. This was true for approval, and for the combination of focusing, prompting and giving answers, where the differences for the means were for all groups in the predicted direction, but did not reach significance. However, with respect to helping the child focus on the verbal task taken as a separate variable, the mothers of HiV girls were significantly higher on this behavior category than the mothers of the LoV girls.

2. The hypothesis that high verbal group mothers should be higher in "Pressure for Improvement" was confirmed for HiV girls as compared to LoV girls. This held true for non-verbal tasks as well as for the combination of verbal and non-verbal tasks, but not for verbal tasks alone.

3. The hypothesis that high verbal group mothers should give help more often after request was confirmed for girls and sexes combined. There were no differences for any of the boys' groups. The number of times a mother helped a child after request was partly a function of the child asking for help. It appeared that the child who had learned to expect an answer, at least intermittently would ask more questions. The child's asking questions in the observed interaction

situation may then be partly a measure of the mother's past (unobserved) behavior in interaction with the child; this category may thus reflect not so much temporary behavior specific to the experimental situation, but rather usual interaction patterns between mother and child.

Considering, then, differences in the children's behavior, the high verbal groups of girls and sexes combined asked for help significantly more often than the respective low-verbal groups. No significant differences were found for boys. An analysis of these data by sex indicated that the total group of girls, on the average, did not ask their mothers for help significantly more often than the boys.

4. The hypothesis that high non-verbal mothers should disapprove and withhold help more often was not only not confirmed, but the observed differences were significant in the opposite direction. High verbal group mothers disapproved and withheld help more often. This was true for girls and sexes combined, while the difference for boys was in the same direction but failed to reach significance. On this measure of "negative" interaction, just as on "help after request," a measure of "positive" interaction, high verbal mothers scored significantly higher. It appears, therefore, that what is important seems to be the degree of interaction between mother and child rather than its content.

5. As predicted, high verbal group mothers asked the observer more questions. This was true for girls' mothers with respect to HiV as compared to LoV groups. Again, no significant differences were found for boys' mothers. It was thought that the mother's need to ask questions about procedure would be a measure of one aspect of her dependency needs. That this measure yielded significant results for girls' mothers, but not for boys' mothers, came as a surprise, but was consistent with results for the other behavior categories where mothers' behavior was found to be significant mainly for girls' discrepancy groups.

6. The hypothesis that high verbal group mothers should give more physical help was confirmed when the Chi-square method of analyzing the data instead of the comparison of means was used. Twelve of the 32 LoV group mothers abstained completely from giving any physical help as compared to four out of the 25 HiV group mothers (X^2 = 4.19; df = 1), a difference significant at the <.05 level for a one-tailed test.

7. The hypothesis that on performance tasks HiV mothers should give help sooner was also confirmed, when they were compared with LoV mothers for the whole sample as to whether they waited 30 seconds or less (8 HiV and 6 LoV), 30 seconds to five minutes (13 HiV and 12 LoV), or more than five minutes (3 HiV and 14 LoV) before helping physically. The difference was significant (X^2 = 4.73; df = 2) on the .05 level for a one-tailed test.

The pattern of behavior of the high verbal girls' mothers was thus quite different from the behavior of the low verbal group. The HiV mothers showed on the average more positive and negative interaction with the child, the child asking more often for help and getting the help part of the time. Most of the help was given without being requested by the child, and these mothers helped their children, especially on the performance tasks, in all categories of helping behavior. Their motivation might very well have been their eagerness for the child to do well on the tasks, since these were also the mothers who, on the average, pressured their children more for improvement of responses than the mothers of the high non-verbal children. While thus attempting to help their children, these mothers of high verbal children revealed themselves to be rather controlling and pressuring while the mothers of the high non-verbal group left their children more on their own and interfered less with their responses.

Comparison of Results of Interview and Interaction Situation

Comparing the results of the interview with those of the interaction situation, it appeared that the interview variables that distinguished significantly between groups did so mainly for boys, while the observation situation variables did so mainly for girls.

Several possibilities that might explain this discrepancy have to be considered. One is the difference in means and variability for the whole group of girls as compared to the whole group of boys. Comparing all the help-giving activities in the interaction situation, one finds that the means on these variables were consistently, though not significantly higher for the girls than for the boys. The lower means for boys, in addition to smaller range and less variability of the help-giving variables, could partly explain the fact that the situation measures failed to distinguish between the boys' discrepant abilities groups. (An observation of a father and son interaction might have been more revealing of differences between boys' groups.) However, this explanation does not hold for the interview. The interview variables which differentiated the ability groups for boys and not for girls did not show consistent differences in means and variability.

Another possible explanation for the difference between results from interview variables and situation variables may be found in the time factor. Most interview variables refer to the child's early history, while the situation variables refer essentially to present behavior. Could one assume that it is at an early age that child training practices influence boys' cognitive development but that girls' cognitive development is differentially enhanced by parents' attitudes and behavior at a later time during childhood? This would contradict what we know about the relative stability of specific abilities (Sontag et al., 1958). Yet, one cannot exclude the possibility that the significant antecedents during infancy for the development of verbal ability may not be identical for boys and girls. Kagan, also, has suggested that different agents may be responsible for the degree of development of different cognitive styles in boys than in girls (Kagan & Moss, 1961). It may be that early verbal stimulation is more decisive for the development of verbal ability in boys. In this connection, it is interesting to note that Levy (1943), who found maternal overprotection associated with high verbal ability, had almost exclusively boys in his sample.

There is one further reason that might be considered for the differential significance of the interview and situation data for boys and for girls. The validity of the interview as a measurement may be greater for boys than for girls. If it can be assumed that mothers feel more responsible about the development of their daughters than their sons (partly because of a culturally accepted feeling, "like father, like son"), then one might expect more defensiveness on the part of the mothers of the LoV girls than of LoV sons. While mothers were quite aware of their children's verbal ability, since it is reflected in reading ability and vocabulary, they were less aware of their children's spatial ability. There was therefore no reason for the mothers of the HiV-LoSpace girls to defensively enhance the role of non-verbal stimulation provided for their daughters. Yet, being often aware of their daughters' low verbal ability, some of the LoV girls' mothers may have tended to exaggerate the verbal stimulation they gave to them.

At the present time, there is not enough evidence to explain definitely the lack of more complete consistency between the results from the interview and the interaction situation.

Implication of Results

Considering all the results which indicate that the HiV groups have received more and earlier help, physical or verbal, on non-verbal tasks as well as verbal tasks, a possible question arises about interpreting the mother's behavior as an antecedent to the child's cognitive functioning. One might argue that mothers of the HiV group whose children are low in space or number have developed a pattern of helping their children more on performance tasks, because their children showed more difficulties with such problems. However, one of our non-verbal tasks, the "Healy Picture Completion" did not involve spatial ability. Furthermore, if the child's ability had consistently determined the mother's degree of help-giving behavior, the mothers of high verbal children would have presented verbal tasks to them without any admonishment, realizing that their children have little difficulty with verbal tasks. Nevertheless, mothers of HiV girls scored significantly higher on "focusing" their children's attention on these verbal tasks than mothers of LoV girls.

We therefore felt entitled to interpret the mother's behavior in the interaction situation as a sample of the kind of behavior which in the past was antecedent to the child's cognitive development.

The data do not support the contention that a child develops a particular ability because his parents are selectively training him in it. Rather, the high level of interaction between mother and child must produce some intervening conditions which enhance verbal more than number or spatial performance.

The essential condition for the development of verbality is probably the close relationship with an adult, and verbal ability is fostered by a high degree of interaction between mother and child. In contrast, the development of number ability requires, above all, concentration and ability to carry through a task by oneself. Similarly, spatial ability is probably developed through interaction with the physical rather than the interpersonal environment. A marked pattern of help seeking and help-giving interferes with the development of an independent and self-reliant attitude, which may be the intervening condition for a high degree of development of spatial and numerical ability.

It seems therefore likely that the mother of a child in the HiV-Low non-verbal group is much more emotionally involved with her child, having given more attention and stimulation to the baby, but tending to pressure, restrict, and control the child more later than the low verbal, high non-verbal mother.

Summary

It was the purpose of this study to examine the differences in mothers' child rearing practices and in their behavior with their children in relation to differences in children's cognitive development.

The subjects were 60 mothers of fifth grade children of either high or low verbal ability with similar total I.Q., the compensating non-verbal ability being spatial or numerical ability.

A comparison of the high with the low verbal group on an interview, questionnaire, and a mother-child interaction situation showed the following significant differences.

In accordance with predictions, high verbal group mothers (whose children were low in either spatial or number ability) gave their children more verbal stimulation during infancy and early childhood, remembered a greater number of their children's early accomplishments, let their children participate more in meal conversations, punished them less for poor speech, bought more story books for them, and criticized them more for poor academic achievement, used anxiety arousal more in cautiousness training, showed less permissiveness with object experimentation, had more restrictions, and perceived their husbands as stricter than themselves. Contrary to predictions, not the mothers' but the fathers' reading time was very significantly higher for the HLV girls' group.

With respect to the observation session, as predicted, high verbal group mothers were found to be higher than low verbal group mothers in all categories of helping behavior, in pressure for improvement, in giving help after request by child, in asking the observer more questions, in giving more physical help and in giving such help sooner. Contrary to the prediction, HLV mothers were also higher on withholding help and disapproval than the LHV mothers.

The findings led to the general conclusion that discrepant verbal ability is fostered by a close relationship with a demanding and somewhat intrusive mother, while discrepant non-verbal abilities are enhanced by allowing the child a considerable degree of freedom to experiment on his own.

Footnotes

[1] This paper is based on a doctoral dissertation submitted to Stanford University. The writer wishes to express her appreciation to Dr. Lucy Rau and Dr. Eleanor Maccoby for their help and generous assistance with this project.

[2] One of the investigators engaged in the larger research project distributed the cases between the two interviewers in such a way that each had an approximately equal representation of cases from each group in her interview sample.

[3] Three additional variables distinguished between high and low number groups.

[4] It appeared, in retrospect, that the variable "democratic discussion" related less to the freedom to talk than to the child's freedom not to have to join in the family's undertakings and to be free from authoritarian family control. This variable may then reflect a certain aspect of independence granted to the child. An analysis of the data comparing HiV-LoN with LoV-HiN children revealed that the HiN group was higher than the LoN group on this variable, the significance reaching the <.10 level for a two-tailed test.

[5] Further analysis of the dependency-independence variables according to whether the compensating ability was space or number revealed that two of the measures of this dimension, while not distinguishing between high verbal and low verbal groups as a whole, distinguished between HiV-LoN and LoV-HiN groups. This was similar to the findings with respect to the variable "democratic discussion" or freedom from authoritarian family control. Greater permissiveness for instrumental dependency was significantly associated with the HiV-LoN group and the objectively scaled score for the earliness of independence age was also significantly associated with this group. In retrospect, it appeared that this scale was rather a measure of pressure for achievement than of genuine expectancy of independence in the sense of self-determination. In contrast to the mothers of the HiV-LoN children, the LoV-HiN group mothers expected independence, or rather, achievement later, but tended on the average to let the child struggle more by himself with difficult tasks.

APPENDIX III. THE RELATIONSHIP BETWEEN SOCIAL DEVELOPMENT AND DIFFERENTIAL ABILITIES ON THE SCHOLASTIC APTITUDE TEST

Edward A. Nelsen

The other chapters in this report have dealt in part with the interrelationships between personality characteristics and cognitive functions. The study reported in this chapter is concerned with discovering relationships between social experience and the development of verbal and mathematical abilities.

One line of evidence bearing upon this topic comes from a study by Kuckenberg (1963) on the effects of early father absence. She presents evidence to show that in comparison to control S's, a relatively high-verbal low-math pattern of scores is obtained on the Scholastic Aptitude Test (SAT) by males whose fathers were absent during early life because of military service. She concludes that this relationship reflects cross-sex identification, a conclusion based on the assumption that a relatively high-verbal pattern of aptitude scores reflects an underlying "feminine style," which is maintained throughout childhood and adolescence, despite the return of the father to the family.

A question concerning the sex typing hypothesis concerns the assumption that relatively high verbal scores reflect a "feminine cognitive style" and that relatively high math scores reflect a "masculine cognitive style." In a survey of the literature on sex differences in the development of cognitive abilities, Oetzel cites evidence which supports the contention that males obtain higher scores than females on the math portion of the SAT, although higher verbal scores are found primarily among females who have entered college, the superiority of high school senior girls on this test being only slight. And while girls do better in reading tests in the early school years, by high school age this advantage has disappeared. Thus, it appears that the higher verbal scores obtained by females in college result, at least in part, from the nature of admission standards, in which girls who have high verbal scores are at an advantage, since their high verbal scores compensate for the low math scores typical of girls on the SAT. Furthermore, Oetzel's survey reveals that boys do not consistently demonstrate superiority over girls on math reasoning or computation until adolescence or adulthood, and that girls do not demonstrate a superiority in vocabulary tests through the middle childhood years; even in adolescence, their superiority in vocabulary is small and inconsistent Girls are consistently superior in verbal fluency and in spelling, but these abilities are not included in the measures of verbal ability which Kuckenberg employed. With respect to the measures of verbal ability she did use (the Scholastic Aptitude Test whose verbal section tests primarily vocabulary and reading), and with respect to number ability as she measured it, it appears that a consistent sex-typical pattern of verbal and numerical abilities lasting through middle childhood and adolescence is not clearly demonstrable. Hence, it seems unlikely that early childhood factors, presumably related to sex typing such as father absence, would cause a child to adopt any particular pattern of verbal or numerical abilities and maintain it through childhood and adolescence after the father's return.

Further examination of Kuckenberg's data reveals (as Kuckenberg herself notes) that the relative differences between math and verbal ability resulted primarily because the math score was lower for the father absent S's, while there were no reliable differences in verbal scores. This fact led the author to consider an alternative hypothesis, namely, that this pattern of scores might be the result of tension or disturbance related to the loss of the parent which interfered more with those cognitive functions most important in mathematical reasoning than with those especially required for performance on tests of verbal skills. It would seem that, if Kuckenberg were correct in assuming that the father-absent boys identified with their mothers and hence adopted what she assumed to be a more feminine pattern of abilities (high-verbal low-math), then the father-absent boys should have had higher verbal, as well as lower math, scores than their comparison group. The rationale for this hypothesis is the same as that offered by Maccoby and Rau in Chapter VIII on the basis of their research with fifth graders with discrepant abilities; that is, stress and tension interfere with the ability to concentrate, to maintain attention, and to inhibit immediate motor discharge -- cognitive functions which they hypothesize are particularly important in dealing with academic materials which involve sequential reasoning and the retention and manipulation of symbolic materials.

For the present study evidence was sought in order to evaluate the two aforementioned hypotheses. According to the sex typing hypothesis, the antecedents and correlates of differential math-verbal ability should be similar to those variables which are related to sex classification.

typing, that is, differential kinds and degrees of experiences with each parent. According to the tension-interference hypothesis, it is predicted that tension-producing environmental conditions will be associated with a relatively high-verbal low-math pattern of abilities.

The data for this study were derived from a questionnaire on social history which was administered to incoming freshmen at Stanford University The questionnaire was originally designed to investigate the nature of the association between family status, parent-child relationships, peer group relationships, etc. and college success. However, the questionnaire items were also particularly suited to the purposes of this study since they were phrased in a manner so that one could investigate specific aspects of family history such as the nature of relationship to each parent, the nature of peer group relations, and the conditions under which changes in family status occurred (e.g., separation, death, remarriage, age at which these changes occurred, etc.). The data were analyzed separately by sex and the results are interpreted chiefly with respect to within-sex differences in math-verbal abilities.

Concerning the ability measures, it was felt that difference scores (verbal minus math) would provide the most sensitive statistic for analyzing differential abilities, in that this measure minimized the variance due to differences in "general intelligence," i.e., the variance in common between math and verbal ability, reflected in the correlation between the two abilities. Nevertheless, the math-verbal scores are presented separately in the table of results so the data can be examined in view of the specific differences in each ability classification.

Procedure.

The sample consisted of the following groups: 728 males in the 1959 entering freshman class and 809 males and 419 females in the 1960 entering class. The data on social history were collected during freshman orientation week via a questionnaire designed and administered by the Stanford Counseling and Testing Center as part of a study of personality and college success. The data were recorded on IBM cards which were used in the analysis of results. Some items from the 1959 questionnaire were replaced with new or reworded items on the 1960 questionnaire; however, when an item was very similar or identical on both questionnaires, the data from the 1959 and 1960 male S's were combined. The items selected for this study are presented in the results section. The Scholastic Aptitude Test (College Boards) is required of all entering freshmen and the verbal and math scores were taken from records stored on IBM cards.

Results

In order to test the extent of the relationship between the biographical inventory responses and differential abilities, the significance of the differences between difference scores (verbal minus math) were determined by use of Analyses of Variance, Critical Ratios, and t-tests for N less than 50. A summary of the significant results is presented in Table 1. Those items which did not significantly differentiate in terms of difference scores are as follows: A. Items administered to the 1959 sample of males only: 1) "Father's age at birth. . ." 2) "Frequency of mother's absence. . ." 3) Kind of punishment: "told not to do it, severely scolded, kept from doing things,

Table VII.1

Verbal, Math, and Difference Scores on the Scholastic Aptitude Test as a Function of Responses to Biographical Questionnaire

			MALES						FEMALES					
			N	Mean Verbal	Mean Math	Diff.	D_g	T-test or C.R.	N	Mean Verbal	Mean Math	Diff.	D_g	T-test or C.R.
FATHER LIVING:	Yes	1a)	1393	596.9	651.6	-54.7	15.9	1.7**	387	634.9	613.3	+21.6	17.3	1.3
	No	1b)	67	603.4	642.2	-38.8			27	642.9	599.6	+43.3		
MOTHER LIVING:	Yes	2a)	1419	597.0	651.7	-54.7	23.8	1.6	405	629.1	602.8	+26.3	3.0	---
	No	2b)	26	619.5	640.4	-20.9			13	636.6	613.3	+23.3		
FATHER REMARRIED (Mother not living)	Yes	3a)	9	621.1	627.7	-6.6	73.4	1.0	7	647.1	627.1	+20.0	46.7	---
	No	3b)	4	590.0	670.0	-80.0			3	613.3	546.6	+66.7		
YOUR FATHER WAS AWAY FROM HOME DURING YOUR CHILDHOOD FOR PERIODS AS LONG AS:								F-test						
Never longer than a day; occasionally for a week		4a)	519	590.0	654.5	-64.5			No data on females					
Occasionally for approximately a month's time		4b)	55	601.3	635.7	-34.4		4.0*						
A year; 1-5 years		4c)	101	616.0	656.2	-40.2								
AS A CHILD YOU WERE:														F-test
Not afraid of your mother		5a)	1006	599.1	634.4	-35.3			205	636.5	616.0	+20.5		
At times afraid of your mother though this was the exception to the rule		5b)	102	593.9	646.7	-52.8		---	117	640.2	603.6	+36.6		3.3*
Often fearful of your mother		5c)	23	606.1	643.4	-37.3			16	678.5	632.8	+45.7		

Table III.1 (con't)
Verbal, Math, and Difference Scores on the Scholastic Aptitude Test as a Function of Responses to Biographical Questionnaire

		MALES					FEMALES				
		N	Mean Verbal	Mean Math	DIFF.	F-test	N	Mean Verbal	Mean Math	DIFF.	F-test
AS A CHILD YOU WERE:											
Not afraid of your father	6a)	615	591.2	632.3	-41.1		209	630.3	617.7	+12.6	
At times afraid of your father though this was the exception and not the rule	6b)	773	601.6	633.2	-31.6	5.5**	166	631.3	606.4	+24.9	1.1
Often fearful of your father	6c)	129	602.3	641.7	-39.4		30	636.8	603.1	+33.7	
AS A CHILD YOU WERE PUNISHED:											
Only by your father	7a)	25	597.0	644.6	-47.6		11	643.4	597.2	+46.2	
Only by your mother	7b)	81	613.8	642.7	-28.9	3.5**	43	647.2	621.3	+25.9	----
By both your parents	7c)	1324	596.8	631.3	-34.5		252	637.9	612.3	+25.6	
Never punished	7d)	37	584.3	631.6	-47.3		12	637.5	599.1	+38.4	
AS A CHILD DID YOU FEEL THAT YOU WERE:											
"Mama's boy"	8a)	83	600.3	640.7	-40.4						
"Daddy's boy"	8b)	19	585.7	614.2	-28.5	3.5*		No data on females			
Neither	8c)	624	594.5	636.5	-42.0						

Table XII.1 (con't)

Verbal, Math, and Difference Scores on the Scholastic Aptitude Test as a Function of Responses to Biographical Questionnaire

		MALES					FEMALES				
		N	Mean Verbal	Mean Math	Diff.	F-test	N	Mean Verbal	Mean Math	Diff.	F-test
DURING YOUR CHILDHOOD AND ADOLESCENCE YOU:											
Always talked over your personal problems with your father	9a)	117	590.6	620.8	-30.2		39	628.2	606.0	+22.2	
Only now and then did you talk about personal affairs with your father	9b)	580	570.9	632.4	-61.5	4.6*	136	664.0	645.3	+18.7	3.2*
Almost never talked about personal problems with your father	9c)	800	603.8	653.4	-49.6		232	637.3	611.4	+25.9	
WHICH OF THE FOLLOWING BEST DESCRIBES YOUR FRIENDSHIP DURING ADOLESCENCE?:											
Lots of friends and a few close friends	10a)	936	590.0	642.6	-52.6		267	631.7	612.9	+18.8	
A few close friends	10b)	437	612.1	655.4	-43.3	4.7**	138	655.0	612.1	+42.9	3.1**
Lots of not very close friends	10c)	51	611.2	663.4	-52.2		26	643.3	603.0	+40.3	

* Significant at .05 level; ** Significant at .01 level.

1 Since this difference is a replication of Carlsmith's finding, a 1-tailed test was used. All other significance levels were evaluated with a 2-tailed test.

spanked, or severely thrashed." B. Items administered to 1960 sample of males and females: 1) "Mother remarried (analyzed for "Father dead, Mother dead," etc.) C. Items administered to entire sample: 1) "Your parents: are together, considered separation, were separated, were divorced" 2) "Strictness of parents and frequency of punishment. . ." 3) Frequency with which personal problems were talked over with mother.

Discussion

The results of this study are consistent with Kuckenberg's findings that, for males, father absence is associated with a relatively high-verbal low-math pattern of ability. In this study, males who report their fathers were absent for extended periods obtained higher verbal scores on the SAT. In addition, males whose fathers were deceased obtained relatively high verbal and low math scores. Although this difference was relatively small, it appears to be reliable.* As regards those items which appear to be indicative of the degree of "psychological closeness" to the father, one finds support for the sex typing hypothesis, if one assumes that a close relationship is an important condition for sex typing. Thus, males who report having talked over personal problems with their father, that they did not fear their father, and that they were punished only by their father, all tended to obtain relatively high math scores. On the other hand, the sex typing hypothesis appears to be directly contradicted in that a large decrement in math ability is found among males who report having been a "daddy's boy." Nevertheless, this finding could be reconciled with the sex typing hypothesis if it could be shown that these fathers revealed certain feminine characteristics such as might be involved in developing such an intense relationship with a child.

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* Since this finding was predicted by both hypotheses, and since it is a replication of Kuckenberg's results, a one-tailed test would be indicated, bringing this difference beyond the .05 level of significance.

In applying the sex typing hypothesis to the results with respect to the male's relationship to his mother, one finds a less consistent picture. Clear support comes from the findings that relatively high-verbal and low-math patterns are found among subjects who report have been a "mama's boy" or having been punished exclusively by their mothers. However, the tendency for subjects who report being fearful of their mothers to obtain higher verbal scores, although not statistically significant, appears counter to the sex typing hypothesis. Furthermore, males whose mothers have died tend to obtain higher verbal scores, although in the cases where the evidence is available, this appears more pronounced if the father remarries. (In those few cases where it can be shown that the father did not remarry, a high-math low-verbal pattern is evident, again supporting the sex typing hypothesis.) No other items reflecting the extent of closeness to the mother differentiated in terms of discrepant abilities.

With respect to females, the results do not indicate that the extent of physical presence or psychological closeness can account for differential patterns of ability in terms of sex typing. On the contrary, fearfulness of one's mother is associated with high verbal ability, as is the tendency to be punished exclusively by the father. Findings among the other items, seemingly related to sex typing in girls, were neither positively nor negatively related to the differential ability measure. Thus, one might conclude that the sex typing hypothesis, applied in the general form as it was in this study, accounts for differential patterns of ability reasonably successfully when applied to the nature of father-son relationships, but in regard to the data on girls and on mother-son relationships, it fails to adequately explain the results and in some cases is directly contradicted by the data concerning the nature of the differential development of math and verbal ability.

A different picture emerges if one examines the results in light of Maccoby and Rau's hypothesis. By assuming that the loss and/or absence of a parent produces stress, their tension-interference hypothesis would appear to explain the relation of father absence to a high-verbal pattern of abilities. On the basis of this assumption, one should also expect a similar relationship in cases of parental separation and divorce and mother absence. There is a slight tendency for boys whose mothers have died to obtain higher verbal scores, but this only approaches significance and does not hold up for girls. Furthermore, the frequency of mother absence was not found to be related to ability patterns. However, for both sexes there was a slight non-significant tendency for parent separation and divorce to be associated with higher verbal scores. Thus, in general, disruption of family status appears to be slightly associated with a tendency to obtain higher verbal scores on the SAT, lending some slight support to the tension-interference hypothesis

As regards the psychological relationships to the parents, the most direct support for the tension-interference hypothesis comes from the finding that fear of parents is associated with higher verbal and lower math scores for both males and females. An interaction involving inter-sex relationships is manifested in that the differences are clearly significant only with respect to fear of the same-sexed parent. Examination of the data reveals that these differences in significance level result because there are fewer cases in which subjects report fearing their opposite-sexed parent and because the differences between groups are less pronounced in these cases.

As in Maccoby and Rau's study, a rather complex picture emerges concerning the dependency relationships between the child and his parent. Although the questionnaire items used in this study were not originally designed so as to be comparable to Maccoby and Rau's, the items are quite similar, and the findings with respect to dependency appear quite consistent. In this study males who reported talking over personal problems with their fathers tended to obtain higher math scores, thus paralleling Maccoby and Rau's finding that high-math children were more likely to ask for help when sick, alone, or afraid. Thus, both studies suggest that high dependency anxiety might be associated with a high-verbal low-math pattern. On the other hand, subjects who reported having been a "mama's boy" or having been punished exclusively by the mother tended to obtain higher verbal scores, a finding which seems parallel to Maccoby and Rau's observation that mothers of high-verbal children were more intrusive and demanding when interacting with their children. Furthermore, in this study it was found that males and females who report having had lots of friends, as well as some close friends, tended to obtain higher math scores, a finding clearly consistent with Maccoby and Rau's finding that high-math children were rated by peers as more popular socially and less withdrawn. On the basis of the total picture which emerged from their research, Maccoby and Rau concluded that "a close, intense relationship with parents. . .in some way interferes with relationships with people outside the family, especially with peers." This appears to be consistent with the picture which emerged in this study, a conclusion further supported by the finding that males who report having been "mama's boy" or "daddy's boy" are more likely to report having had only a few close friends or lots of friends who were not close.

The tension-interference hypothesis, in the general form, does not specifically predict these findings concerning the dependency relationships of the child with his parent. However, as in Maccoby and Rau's study, it does appear to give some explanation as to why those individuals who have more intense relationships with either parent, but inadequate relationships with peers, have difficulty in solving math problems.

Nevertheless, the chief difficulty for the tension-interference hypothesis is its inability to differentiate the nature of the tensions which would lead to the greatest interference. For example, it is not clear why separation and divorce do not lead to greater disturbance nor why items differentiating the severity and nature of punishment do not reveal differences in math or verbal ability as one might expect.

There is some evidence in Maccoby and Rau's research and in this study to suggest that anxiety over interpersonal relationships -- with peers and with parents -- is one of the conditions which leads to a decrement in math ability. Further support for this hypothesis comes from the research of Green (See Appendix IV) who has experimentally demonstrated that after a period of isolation, fourth grade children showed a greater decrement in performance on a task requiring short-term retention of symbols when they were distracted by a warm, nurturant voice, than when distracted by mechanical sounds; whereas non-isolated children showed no such decrement.

It will be recalled that in Carlsmith's study, the losses among the father-absent boys were in mathematical performance, not accompanied by corresponding gains in verbal performance, and we felt that this particular kind of difference would be better accounted for by the tension-interference hypothesis than by the hypothesis that father-absence leads to feminine sex typing. It should be pointed out that in the present study the greater verbal-over-math discrepancy score of the father-absent boys resulted in part from rather small losses in math performance and in part from rather small gains in verbal. It is difficult to know how to interpret this fact. Analysis of the specific losses and gains in verbal and mathematical performance separately must be based on some assumptions about the initial equivalence in "general intelligence" between the groups prior to the particular experiences (such as father-absence) which we assume led to a differential pattern of abilities. There is the further problem of dealing with highly selected college populations, in which, if math performance in math, verbal performance must be relatively strong for the student to be admitted to college. It is possible, then, that the male students who have relatively high verbal scores, by comparison with their math scores, had initially higher general potential than the average of other students and underwent experiences which differentially weakened their math scores, leaving them with total scores still acceptable for college entrance because of their continuing high verbal scores. But this is all speculation and the fact remains that Kuckenberg's data are more consistent than ours, on this particular point, with the tension-interference hypothesis.

Although both the sex typing and the tension-interference hypotheses appear to account for some of the findings, neither hypothesis in isolation presents a highly consistent explanation. Therefore, a re-examination of the data led the author to propose a new hypothesis integrating both of the aforementioned hypotheses. Whereas Kuckenberg assumes that the relationship between verbal and math scores reflects "feminine or masculine styles" adopted in the process of identification, it is proposed by the author that inappropriate sex typing is one of the conditions which would produce the social isolation, tension, distractability, etc. which characterizes individuals who have difficulty with math problems. Assuming that punishment by one's opposite-sexed parent leads to inappropriate sex typing, this hypothesis would appear to be most consistent with the finding that punishment by the opposite-sexed parent is associated with high verbal ability for both sexes (significant for males only). Furthermore, it would be consistent with the findings regarding father and mother absence, and would give some basis for an explanation regarding the interaction involving inter-sex relations on the "Fear of parents" theme. Also, one might speculate that inappropriate sex typing would lead to greater disturbance in males in American middle class culture, thus explaining why the results were more pronounced for males than for females.

Summary

As freshmen, 1,556 college students were given a biographical questionnaire concerning family and social relationships. The responses to this questionnaire were analyzed in terms of differential math-verbal ability. Relatively high-verbal low-math patterns of ability were found among male S's who reported that: their fathers were not living, their mothers were not living and their fathers had remarried; their fathers were absent frequently or for long periods of time; they were punished only by their mothers; they almost never talked over personal problems with their fathers; they had been "mama's boys" or "daddy's boys"; they were often fearful of their fathers. This pattern was found among females who reported they were often fearful of their mothers; that only sometimes did they talk over personal problems with their fathers. Relatively high-math low-verbal patterns were found among male S's who reported that: their fathers were not absent from the home very often; that they were punished by their fathers only; that they always talked over personal problems with their fathers; and that they were not afraid of their fathers. This pattern was also found among females who reported that they were not afraid of their mothers and among subjects of both sexes who reported that they had lots of friends as well as some close friends. These results were considered in relation to two hypotheses: 1) sex typing, and 2) differential facilitation or inhibition resulting from tension-producing environmental conditions.

APPENDIX IV

SOCIAL ISOLATION AND THE EFFECTIVENESS OF DISTRACTORS*

Lance K. Canon

The impetus for the present study stems from research conducted by Maccoby and Rau on the relationships between personality and cognitive functioning of children with discrepant intellectual abilities. One aspect of this study concerned itself with certain differences in distractibility between a group of children selected as having high verbal facility and a group characterized by high numerical ability. In one of the situations investigated the children's ability to work effectively on a task while distracting material was played to them over earphones was tested. It was found that high-number children were significantly less distractible than were high-verbal children and the authors suggest that this effect has its origins in differences in the past experience of these two groups of children. From an analysis of observations gathered by Bing in a situation in which the mothers of these children presented them with a series of tasks, it was shown that the mothers of high-verbal children tended to interact more with their children and were more intrusive in relation to mothers of high-number children. Thus, it was hypothesized that the high-verbal children's parents had actively interfered with their development of resistance to distraction by consistently presenting them with "extraneous stimuli which the children would not dare to ignore, namely, the parent's own intrusive participation" (p. 199, , this report). The following statistically significant correlations were found between distractibility and Bing's measures of mother-child interaction: between the measure of distraction for the child and "fostering independence" on the part of the parent, -.39 (boys only); between "distraction" and "pressure for impoovement on tasks" by the parent, .59 (girls only); between "distraction" and "pressure for school achievement from the parent " .35 (boys), .37 (girls). Thus, differential ability to resist distraction has been demonstrated to be a function of the past experience of the individual -- in this case, well established expectancies as to the probablereward value of intrusive stimuli occurring during task-oriented behaviors. But what of the possible effects of more immediately prior conditions on distractibility? Is the ability to resist responding to stimuli that are irrelevant to an on-going course of action a reasonably stable personality trait to be conceptualized as a factor which individuals possess in a certain degree with reference to a wide variety of situations? Or is it, rather, a trait which can be significantly influenced by the situation which obtains at the moment? It is to these questions that the present study addresses itself.

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* This report is made up primarily of the procedures and results sections of a full report which will be submitted for separate publication. Omitted here are the review of the literature, most of the theoretical background on anxiety and dependency, and the discussion section following presentation of the results.

The specific interest of this research is an hypothesized interaction between anxiety produced by social isolation as a prior condition and the nature of the distractor involved. Gewirtz and Baer (1958) and Hartup (1958) have shown that performance on a task is improved following social isolation, when the situation is such that adult approval will reinforce the performance of the task. These studies can be interpreted as showing that social isolation enhances the effectiveness of social reinforcers (Gewirtz, 1959). In the present study the effect of social isolation should be such as to interfere with task performance, for the design is such that the effectiveness of a distracting stimulus, rather than a reinforcer, should be enhanced.

The present study holds that social isolation of children will indeed lead to an increase in the potency or salience of social stimuli, specifically adult verbal stimuli and that the mediating factor is anxiety (cf. Walters & Ray, 1960) resulting from that isolation. Two sub-groups will be drawn from the initial sample of children to be tested, one of which will be isolated in a manner similar to that used by Walters and Ray with their anxiety-isolated subjects for a period of 20 minutes prior to working on a task while the other will come directly from their school classroom to the task with no interpolated manipulation. A further independent variable will be the nature of the auditory distractor involved. All subjects will work under two distractor conditions: a tape recording of an adult female voice relating a melodramatic story about a little lost boy or girl who is at last found by overjoyed parents, henceforth designated as the "nurturant" distractor (ND); and a tape recording of a wide variety of non-human sounds, e.g., train, typewriter, birds, running water, etc., to be designated as the impersonal distractor (ID). Each S will work on two equivalent forms of the same task, one under each of the two distractor conditions and the primary measure of his ability to cope with auditory interference will be the time taken to complete the tasks.

The following predictions are advanced:

1. Isolation, as affected here, will produce heightened anxiety which will lead to an increase in the incidence of responses designed to reduce that anxiety. Since one wuch response is "better" (i.e. more rapid) performance which the S may perceive as instrumental in eliciting approval from E or simply as a method of more quickly espaping the situation, a definite tendency toward lower task time with prior isolation will be predicted.

2. However, the tendency predicted above will be qualified for those S's operating under isolation, nurturant distraction conditions, for here the S may satisfy his primary goal, some degree of anxiety-reduction, simply by more closely attending to the reassuring female voice he hears over the earphones. Thus, it is predicted that with prior isolation rapid performance will be significantly interfered with by the nurturant distractor relative to time to complete the task with the impersonal distractor.

Experimental design and procedure

Twenty male and twenty female children enrolled in the fourth grade of a local elementary school served as subjects in this experiment. This sample constituted almost the entire fourth grade population of the school.

Since the central concern of this study was to investigate the ability of children to work effectively under auditory distraction, an attempt was made to select a task of such a nature that performance on it would be reasonably sensitive to the influence of such a distractor. With this desire in mind a test was constructed which it was thought would require the subject to keep a specific item of information "in mind" over a period of time and to break set, that is, to work with new such stimulus items frequently. It consisted of a series of "master cards" on which were stenciled five pairs of symbols (letters of the alphabet or geometric figures) one of which was underlined. Following each of these master cards were three "test cards" which again had five similar pairs of symbols. The S's job was to look at the master card, find the underlined symbol (e.g., MN, nN, NM, mN, NN or θe, θθ, ee, eθ, θe) and remembering its exact nature, move through the following three cards marking with chalk any identical symbol found. He was told that the sought after symbol might appear on any one or more of the test cards and further, that he might check back to the master card at any time. Two forms of the test were constructed and were matched for number of symbol sets, type of symbols number and order of correct symbols on the test cards. Pre-testing showed the two forms to be of approximately equal difficulty as measured by time to completion, and there appeared to be a reasonably stable practice effect whose influence could be effectively eliminated in the testing situation by balancing procedures.

The nurturant distractor was a tape recording of an adult female voice relating an emotional story about a boy or girl (same-sexed as S) who was separated from his parents who were quite upset by it all. They are finally reunited and a party is given in celebration. The story is characterized by frequent assurances, nurturant statements, and questions directed to the listener.

For the impersonal distractor a series of 25 different sounds were recorded including both familiar (dogs barking, typewriting, phones ringing) and more novel (telegraph key, gong, steam train) stimuli.

Subjects were randomly assigned to conditions of isolation or non-isolation with 10 males and 10 females in each of the two groups. Subsequently the order of presentation of the two distractors and the order of presentation of the two forms of the test were balanced by random assignment, as far as was possible, over all S's.

The children were called from their classroom by a note sent to their teacher and they were not told at that time the reason for this. When a non-isolation S arrived in the test room, he or she was introduced to the male E by the school principal who was a quite familiar figure to them, and was told that E would like them to "help him out" by working for a few minutes on a job he had for them. After the S assented, the principal left the room and E proceeded to spend a few minutes in casual conversation in an attempt to put the S at ease and establish a degree of rapport. The nature of the equipment and the task was then explained as was the fact that none of this was connected with the school and that no one would see a record of S's performance.

S's operating under isolation conditions were met by E alone in the hallway and with no introduction or explanation were told to follow E who led them to a room which they had probably never had reason to enter before (an office used only by the attendance clerk). Here they were told that they had been selected to be given a special test, that the complicated apparatus and materials had not yet been completely set up at this time and that they were to wait in the adult sized chair there (facing a blank wall) until someone called for them. The room was bare except for a desk and steel cabinet and the only window was shaded. After a 20-minute period the S was taken to the experimental room and given the same instructions as were the non-isolated S's. After the termination of the tests several minutes were spent reassuring S, apologizing for the delay and answering any questions he might have. All S's were requested not to discuss the test procedure with their classmates and verbal reports indicated that this request was well complied with.

Measurements were taken of the time the S took to finish each of the two tasks he worked on, of the number of errors he made, and of the number of times he checked on his accuracy by returning to a master card.

Results

Equivalence of task forms

That the two forms of the test were equal in difficulty is shown by the fact that over all S's and all conditions the mean time to completion for Form A, in minutes, was 5.386 and for Form B, 5.367, a non-significant difference. Again, over all S's and conditions there was a mean decrease in time to completion between the form given first and that one given second (a practice effect) of 0.4965 minutes. It should be remembered, however, that the influence of this practice effect should not enter into the primary data in a direct fashion because of the balancing features of the design.

Analysis of variance

A multiple analysis of variance was carried out on the basic measure employed -- time to completion of the task. The results of this analysis are presented in Table 1.

It is thus seen that the effect of the type of distraction under which the S must work has a definite influence on his performance and further that there is a strong interaction between the experimental variation of the experience of the S just prior to his work on the task (isolation or non-isolation) and the nature of the distracting stimuli.

Task completion time scores over all subjects

With these general trends established, let us turn to an examination of their specific nature. Table 2 expresses the relationships involved in terms of mean time to task completion for both sexes combined.

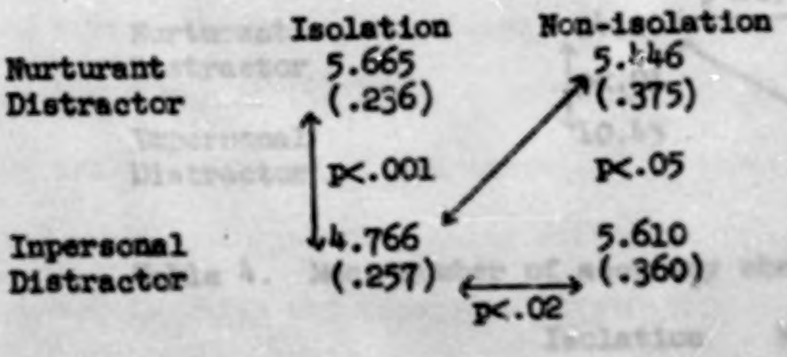
The data show that under non-isolation conditions there is no significant difference in the disruptive influence on performance of the two types of distractors, but that the impersonal distractor is non-significantly more attended to.

Prediction (1) receives strong support. Performance in the isolation impersonal distractor situation is significantly more rapid ($p <.05$, $p <.02$) than it is following no isolation with either of the distractor types. It does appear, then, that the introduction of a period of social isolation immediately antedating work on the task does lead to an increase in the speed of performance, but not to any increase in the tendency to attend to an impersonal distracting

Table 1. Analysis of variance

Source	df	SS	F	p
Between subjects	39	52.0372	1.0644	n.s.
B (isolation)	1	1.8363	1.4648	n.s.
C (sex)	1	1.7405	1.3884	n.s.
BC (isolation x sex)	1	3.3292	2.6557	n.s.
error between	36	45.1312		
Within subjects	40	33.5285	1.2345	n.s.
A (distractor)	1	2.8427	4.1866	<.05
AB (distractor x isolation)	1	5.8318	8.5888	<.01
AC (distractor x sex)	1	0.2121	0.3124	n.s.
ABC (distractor x isolation x sex)	1	0.1961	0.2888	n.s.
error within	36	24.4458		

Table 2. Mean time to complete task (sexes combined) in minutes



	Isolation	Non-isolation
Nurturant Distractor	5.665 (.236)	5.446 (.375)
Impersonal Distractor	4.766 (.257)	5.610 (.360)

All p-values are two-tailed and were calculated by the use of the appropriate t-test for differences between means with small samples.

Figures in parentheses are standard deviations.

stimulus. And, although the data do not unequivocally demonstrate this it would seem plausible to assume that the impersonal distractor is less interfering is paid less attention to, under the isolation conditions than under the non-isolation conditions.

Finally the highly significant difference ($p < .001$) between performance times under the two distractor conditions subsequent to isolation nicely substantiates the second prediction that relative to performance with the impersonal distractor, the nurturant distractor would lead to increased time taken to complete the task.

Error and accuracy check scores - all subjects

The number of errors made and the number of times the S referred to the master card in order to check on the accuracy of his work were recorded and these results are presented in Tables 3 and 4.

Table 3. Mean number of errors - all subjects

$$\begin{tikzcd} & \text{Isolation} & \text{Non-isolation} \\ \text{Nurturant Distractor} & 14.20 \arrow[r, leftrightarrow, "p<.05"] \arrow[d, leftrightarrow, "p<.01"'] \arrow[dr, leftrightarrow, "p<.03"] & 9.00 \\ \text{Impersonal Distractor} & 10.45 & 7.50 \end{tikzcd}$$

Table 4. Mean number of accuracy checks - all subjects.

	Isolation	Non-isolation
Nurturant Distractor	5.85	8.10
Impersonal Distractor	6.35	8.75

The information of greatest relevance to be taken from Table 3 is that although S's show a general tendency to make more errors under isolation than under non-isolation conditions, these differences are not statistically significant with reference to the impersonal distractor. That is, there is not a significant increase in the number of errors made for the isolation impersonal distractor situation as compared with either of the two distractor conditions and non-isolation. However, the error increase for isolation and the nurturant distractor is significant. Thus, isolation does appear to have a qualitatively different effect on performance as a function of the nature of the distracting element involved. This demonstrates that more rapid performance need not come about at the expense of accuracy and, in the context of our theoretical position, that the anxiety presumably resulting from isolation does not necessarily lead to an increase in errors but may rather result in more efficient and affective performance. However, with the introduction of the nurturant distractor the number of errors increases to a level which is significantly greater than that for any of the other conditions indicating that the S is giving at least a portion of his attention to something other than the task before him, a situation quite different from that previously discussed in which the impersonal distractor was operating.

No statistically significant results occur in the analysis of the number of times the S checks on his accuracy at the task, but there is a general trend toward the appearance of less of this procedure under isolation conditions as compared with non-isolation conditions. It should be noted, however, that this trend is associated with increased efficiency with the impersonal distractor and with decreased efficiency when the nurturant distractor is involved. In the former case it seems plausible to assume on the basis of the time and error scores that the decrease stems from heightened attention to the task and its demands while the latter tendency may well have a distinctly different source -- the S is here predisposed to be less concerned with the accuracy of his performance and more interested in the nurturant distractor.

Data break-down by sex.

When the data are broken down into separate analyses by sex, the inter-cell relationships remain essentially the same but certain differences in magnitude indicate the existence of sex differences which are of interest. Tables 5a and 5b represent the time scores for the two sexes.

Table 5a. Time Score Means - Males

	Isolation	Non-isolation
ND	5.728 (.731)	5.800 (1.07)
	p<.001	p<.05
ID	4.609 (.899)	5.959 (1.02)
	p<.02	

Table 5b. Time Score Means - Females

	Isolation	Non-isolation
	p = .12	
ND	5.602 (.797)	5.093 (1.024)
	p<.005	
ID	4.924 (.725)	5.260 (1.008)

Figures in parentheses are standard deviations.

The most striking difference between the sexes is the more rapid performance of the females than the males under both distractor conditions with non-isolation. A further break-down of these data yields a mean for females under both distractor conditions and non-isolation of 5.176 minutes and for males 5.879 minutes which is a difference significant at the .05 level. The corresponding mean scores under isolation conditions are 5.263 and 5.168, and this difference is not significant. At least two interpretations of this finding are possible and the experimental design does not permit a clear-cut choice between them. It may be that girls at this age characteristically perform more efficiently and more rapidly on the type of task employed in this study than do boys, or perhaps girls' performance is simply less disrupted by distraction than is boys' in this sort of situation. The first explanation is favored by the author for two reasons. First, the Maccoby and Rau work on distractibility of children in a similar age range found no sex differences in distractibility, and second, studies by McNemar (1942) Schneidler and Paterson (1942), and Wesman (1949) have indicated that females may be possessed of greater facility with regard to tasks conceptually similar to the one employed in this experiment (the Stanford-Binet tests of matching objects and coding; the Differential Aptitude Test measure of clerical ability; and the Minnesota Vocational Test for Clerical Workers). But, of course, this does not rule out the possibility that the latter explanation may be the more correct one.

It is also to be seen that the male pattern resembles very closely the total one discussed earlier while the females' exhibit the same general trends but their performance appears more stable over all conditions. The main effects are present as predicted but their magnitude in terms of inter-cell differences is less than that of the comparable male differences. The most simple summary of the sex differences would be then, that the girls are more proficient at the task under non-isolation conditions and their performance appears to be less strongly influenced by isolation than is the boys' performance. The isolation impersonal distractor mean score for the males is significantly lower than the mean time score for any other cell while the corresponding datum for the female S's is similarly the lowest cell score, but is not significantly different from the other cell scores. If the girls are performing more efficiently than the boys in the non-isolation condition, it may well be that isolation and its attendant anxiety simply are not able to produce as proportionately great an increase in performance level as this condition does with the initially less efficient boys. It also might be held that interaction with a male E under non-isolation test conditions produces a certain level of anxiety in the children and that this level is higher in girls than in boys. Thus, those girls who are isolated might be thought of as operating with a higher anxiety level than boys in the similar condition who have a more nearly optimal level of anxiety for performance here. Thus, the girls' performance does not benefit as much as does the boys' from the anxiety resulting from a prior isolation period. These hypotheses are, of course speculative and the data do not permit a direct substantiation or repudiation of either of them. However, the error means, to be presented next, seem to make the former interpretation more plausible than the latter, for the girls make fewer errors than the boys under isolation, impersonal distractor conditions not more as would be called for by the second interpretation.

Tables 6a and 6b and 7a and 7b, which present error and accuracy check means for the sexes separately, reflect sex differences which fall in line with the above summary statement. Girls do better than boys under non-isolation -- they make fewer errors and need to check their accuracy less often -- and, in general, the isolation manipulation leads to less marked changes in these measures for the girls.

Table 6a. Error Score Means - Males

	Isolation	Non-isolation
ND	15.8	10.6
		$p < .03$
ID	11.6	7.7

Table 6b. Error Score Means-Females

	Isolation	Non-isolation
ND	12.6	7.4
	$p < .05$	$p < .05$
ID	9.3	7.3

Table 7a. Accuracy Check Means-Males

	Isolation	Non-isolation
ND	6.0	8.2
ID	5.9	9.0
	$p < .12$	

Table 7b. Accuracy Check Means-Female

	Isolation	Non-isolation
ND	5.7	8.0
ID	6.8	8.5

Summary

This study has concerned itself with the influence of certain types of potentially distracting material on the performance of children and with the effect of an immediately prior period of social isolation on distractibility.

Twenty male and twenty female children in the fourth grade of a local elementary school served as subjects in the experiment. One-half of the S's were isolated for a period of 20 minutes prior to the administration of the task in a manner shown by Walters and Ray (1960) to induce a mild anxiety state. The remaining S's were tested immediately after being introduced to E. The task required S to make note of one underlined symbol set in a series of five symbol pairs and then search for identical symbol sets on the following three cards of the task booklet. Fifteen such series were included in the test booklet. S was permitted to check his results at any time. Each S operated under either isolation or non-isolation conditions and was required to work with both a "nurturant" distractor (an adult female voice telling a nurturant story) and an "impersonal" distractor (mechanical and animal sounds). Performance measures included time to complete the task, number of errors made, and number of accuracy checks made.

It was predicted that there would be no significant differences between performance under the two types of distractor with non-isolation; that isolation and the concomitant increased anxiety level would yield more efficient and more rapid performance with the impersonal distractor, only; and that isolation would lead to poorer and less rapid performance with the nurturant distractor since the dependency anxiety aroused by the prior isolation period would bring about an increased tendency to attend to this type of distractor.

Each of the predictions received support from the data at a high level of statistical significance and evidence is discussed which suggests the presence of qualitative differences between performance under isolation, nurturant distractor and non-isolation, nurturant distractor conditions even though there was no difference in the time-to-completion scores. The observed sex differences were discussed in some detail.